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THESIS

AMAZON SURVEILLANCE SYSTEM (SIVAM): U.S. AND BRAZILIAN COOPERATION

by

E. Peter Wittkoff

December 1999

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The thesis will demonstrate how Brazil's System for Surveillance of the Amazon (SIVAM) increases bilateral linkages in Brazilian-U.S. relations within the framework of the international relations theory of complex interdependence. The thesis's central theme is that SIVAM might benefit U.S. national security interests in Latin America, especially in counter-drug operations. For example, an opportunity for greater cooperation between the two nations exists with Relocatable Over the Horizon Radar (ROTHR) data sharing. ROTHR could improve SIVAM's low altitude aircraft coverage and reinforce Brazil's sovereign borders. The most important arena for cooperation is in counter-drug operations.

SIVAM was conceived in the early 1990s to support control and preservation of the Amazon in a strategy known as System for Protection of the Amazon or SIPAM. In 1994, U.S. based Raytheon Corporation won the SIVAM contract over French Thomson CSF in bidding, but contract execution did not begin until 1997. The new Ministry of Defense will probably control SIVAM. SIVAM will have significant surveillance capabilities to support Brazilian military operations other than war (OOTW).

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AMAZON SURVEILLANCE SYSTEM (SIVAM): U.S. AND BRAZILIAN COOPERATION

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requirements for the degree of

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

AEW	Airborne Early Warning
ALX	EMB-314 Super Tucano aircraft
ATC	Air Traffic Control
ATECH	Foundation for Application of Critical Technologies (*Fundacão Aplicações de Tecnologias Críticas)* (replaced ESCA after ESCA was closed)
C^4ISR	Command, control, coordination, communications, intelligence, surveillance and reconnaissance system
C/NCES	Communications/ Non-Communications Exploitation Sensor
CCG	General Coordination Center (*Centro de Coordenação Geral*) (located in Brasilia)
CCSIVAM	Commission for Coordination of SIVAM (*Comissão para Coordenação do Projeto SIVAM*)
CEBRES	Brazilian Center for Strategic Studies (*Centro Brasileiro de Estudos Estratégicos*)
CINDACTA	Integrated Air Defense System (*Centro Integrado de Defesa Aérea e Controle de Tráfego Aéreo*)
CLEM	Clutter Effects Model
CPI	Parliamentary Investigation Commission (*Comissão Parlamentar de Inquérito)*
CPTEC	Weather Forecasting and Climate Studies Center (*Centro de Previsão do Tempo e Estudos Climáticos*
CRV	Regional Surveillance Center (*Centro Regionais de Vigilância*) (located in Belém, Manaus and PortoVelho)
CVA	Aerial Surveillance Center (*Centro de Vigilância Aérea*) (located in Manaus)
DAC	Aeronautics' Department of Civil Aviation (*Departamento de Aviação Civil-* DAC*).*

DEA	U.S. Drug Enforcement Agency
DF	Direction Find
DME	Distance Measuring Equipment (these stations transmit in response to requests from aircraft-based transmitters. The delay between the request and response allows the aircraft equipment to calculate the distance to the DME station)
DOD	U.S. Department of Defense
EAI	Enterprise for the Americas Initiative
ECEMAR	Air Force Command and General Staff School *(Escola de Comando e Estado-Maior da Aeronáutica*)
ECEME	Army General Staff and Command School (*Escola de Comando de Estado-Maior do Exército)*
EGN	Naval War College *(Escola de Guerra Naval)*
EMBRAPA	Brazilian Agricultural Research Corporation *(Empresa Brasileira de Pesquisa Agropecuaria)*
EMFA	Armed Forces General Staff (*Estado-Maior das Forças Armadas)*
EPA	Environmental Protection Agency
ESCA	Automation and Control Systems Engineering (*Engenharia de Sistemas de Controle e Automação)*
ESG	War College (*Escola Superior de Guerra*)
ESTC	Effective space-time coverage
EU	European Union
EW	Electronic Warfare
EXIMBANK	Export Import Bank of the United States
FAA	Federal Aviation Administration
FAB	Brazilian Air Force (*Força Aérea Brasileira*) under Aeronautics Command

FLIR	Forward Looking Infrared
FUNAI	National Indigenous Foundation (*Fundação Nacional do Indio)*
GBR	Ground Based Radar
GOB	Government of Brazil
GPS	Global Positioning System
HF	High frequency radio
IBAMA	Brazilian Institute for the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis)*
IBGE	Brazilian Institute for Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística)*
INPE	National Institute of Space Research (*Instituto Nacional de Pesquisas Espaciais)*
INPA	National Institute of Amazon Research *(Instituto Nacional de Pesquisas da Amazônia)*
IR	Infrared
KW	Kilowatt (a measure of electric power consumption)
MAV	Mission availability rate
MEPE	State Ministry of Special Projects *(Ministério Extraordinário de Projetos Especiais)*
MERCOSUL	South American Common Market (*Mercado Comum Sul Americano)*
MSS	Multi-Spectral System
MST	Landless Movement (*Movimento Sem-Terra*)
MTI	Moving Target Indicator
NASA	National Air and Space Agency

NDB	Non-directional Beacon (used by general aviation for navigation or non-precision approach to some airports)
NOAA	National Oceanic and Atmospheric Agency
NGO	Non-Government Organizations
O&M	Operations and Maintenance
OCC	Operation Control Center
OFDA	Office of Foreign Disaster Assistance
OOTW	Operations Other Than War
OTAC	Organization of the Amazon Cooperation Treaty
OTH	Over the Horizon
PFL	Liberal Front Party (*Partido Frente Liberal)*
PMA	Propagation Management and Assessment
PSB	Brazilian Socialist Party (*Partido Socialista Brasileiro)*
PT	Workers' Party (*Partido dos Trabalhadores)*
ROTHR	Relocatable Over the Horizon Radar
SAE	Strategic Affairs Secretariat (*Secretaria de Assuntos Estratégicos*) (changed to MEPE in January 1999)
SAR	Synthetic Aperture Radar
SENAD	Anti-Drug Secretariat (*Secretaria Nacional Antidrogas)*
SIGINT	Signals Intelligence
SIPAM	System for Protection of the Amazon *(Sistema de Proteção do Amazonas)* (The overall strategy for Amazon security— the new Ministry of Defense will probably retain executive control over SIPAM and will use SIVAM to implement the strategy)
SISNAD	National Anti-Drug System (*Sistema Nacional Antidrogas)*

SIVAM	System for Surveillance of the Amazon (*Sistema de Vigilância da Amazônia)*
SSI	Brazilian Intelligence Agency (*Subsecretaria de Inteligência*)
TCU	Federal Accounting Tribunal *(Tribunal de Contas da União)*
TOS	Time on Station
UHF	Ultra High Frequency
UN	United Nations
USG	U.S. government
USP	University of São Paulo (*Universidade de São Paulo)*
USSOUTHCOM	U.S. Southern Command
VHF	Very High Frequency
VOR	Very-high Omni-directional Range (Stations for long distance aviation navigation transmitting a unique signal that allows an aircraft aloft to determine its bearing relative to the station)
VSAT	Very Small Aperture Terminal (a business or home transceiver that lets hosts and users communicate using a satellite network)

EXECUTIVE SUMMARY

The purpose of this thesis is to analyze the extent to which Brazil's System for Surveillance of the Amazon (SIVAM) will increase bilateral linkages in Brazilian-U.S. relations, especially in the realm of intelligence/data sharing and Operations Other Than War (OOTW) in the Amazon region. OOTWs of importance to U.S. national security interests include those with a focus on environmental protection, sustainable development, border security, and drug interdiction.

SIVAM is a technologically advanced command, control, coordination, communications, intelligence, surveillance and reconnaissance (C^4ISR) system. The system relies primarily on an integrated aggregation of sensors and radars. Brazil purchased the system valued at over one billion dollars in 1995. The system will be located in northern Brazil. The prime contractor is the U.S. based Raytheon Corporation. Brazil is building SIVAM in order to support its national objectives in its Amazon region. These objectives are advertised as non-military in nature. However in practice, SIVAM's integration of advanced aerospace technologies, satellites, electronics and ground sensors could be utilized in a military support role, especially in Brazilian counter-drug efforts.

Brazil has long been concerned with monitoring the Amazon in order to assert sovereignty and control of the region, and sees SIVAM as a way to accomplish this. SIVAM has the potential for acquiring a large amount of intelligence on illegal activities in the Amazon such as drug trafficking, illegal logging and mining. To assert sovereignty and to halt these illegal activities Brazil's law enforcement and military resources may be strained to respond. Despite Brazil's strong sense of sovereignty, it may find it needs U.S. operational support to mitigate problem areas and illegal activities identified by SIVAM.

The thesis is significant in that it contributes to not only understanding SIVAM, but also U.S. national interests in South America and the Amazon region. For instance, combating drug trafficking and ecological degradation in the Amazon are important to U.S. national security interests in the region. Hence, SIVAM may strengthen U.S.

national security interests in Latin America, especially in countering drug trafficking. This is potentially important to the United States due to recent closure of its Panamanian bases, especially the counter-drug facility at Howard AFB. Hence, SIVAM could support U.S. government (USG) counter-drug operations in Latin and South America. Further, the USG might support Brazil's efforts in the same vein. Areas of cooperation include Relocatable Over the Horizon radar (ROTHR) data sharing, intelligence dissemination, logistics and finances.

Thus, SIVAM may increase bilateral relations between U.S. and Brazil due to increased governmental and non-governmental cooperative interaction resulting from U.S. assistance. This increase, should it occur, would support Robert O. Keohane and Joseph S. Nye's international relations theory of complex interdependence. The theory traditionally addressed U.S. relations with major trading partners, through multiple linkages, such as Canada. It explains how military force is not considered a viable option between the two countries. Bilateral relations are safe from aggression by either party. SIVAM increases the complex interdependence of the bilateral relationship between Brazil and the U.S. by providing a significant linkage between the two countries.

The thesis concludes that cooperation between the United States and Brazil will probably improve due to SIVAM's operational capabilities as well as its deficiencies. SIVAM's capabilities can be improved with U.S.-Brazil integration/cooperation. For example, SIVAM's low altitude surveillance coverage could be greatly enhanced by integrating a Relocatable Over the Horizon Radar (ROTHR) into SIVAM. This would improve SIVAM's capabilities to support combatting a growing threat to Brazil's sovereignty: drug trafficking through its borders by low flying aircraft. Commission for Coordination of SIVAM (*Comissão para Coordenação do Projeto SIVAM*- CCSIVAM) should consider working with Raytheon to conduct technical and operational feasibility studies for a SIVAM ROTHR. The three major findings of the thesis are:

1) SIVAM will possesses significant military applications such as supporting intelligence gathering, early warning, aerial interception, and surveillance for OOTW missions such as border security, counter-drug, and environmental protection. SIVAM

will also have capabilities that Brazil's military could utilize for space and aerial collection (intelligence) in order to defend and monitor Brazil's borders with its air and ground surveillance radars, satellite and aerial imaging capabilities, and communications intercept.

2) SIVAM's capability to detect problems in the Amazon has significant implications for military and police in that the large volume of detected problems will place great strain on their resources.

3) U.S. bilateral relations with Brazil, under the complex interdependence framework, could improve especially as SIVAM capabilities could result in Brazil requesting assistance and/or increasing cooperation with U.S. military, law enforcement and intelligence organizations. U.S. governmental agencies or entities will respond if it is in their interest.

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The right to search for truth implies also a duty; one must not conceal any part of what one has recognized to be true. Albert Einstein

I. INTRODUCTION

The System for Surveillance of the Amazon (*Sistema de Vigilância da Amazônia*- SIVAM) is a sensor and radar-based system that will aid the Brazilian military and law enforcement agencies in increasing their influence in Brazil's Amazon region. SIVAM also supports the Government of Brazil (GOB)'s goals of preserving and protecting territorial sovereignty in the vast region. Brazil is establishing SIVAM because it believes it will support strategic policies such as sustained development, environmental protection, and government functions such as law enforcement, air traffic control and border monitoring.

The author interviewed over forty U.S. and Brazilian civilian, military, private and public enterprise officials involved with SIVAM. Their input was critical to the development of this thesis. [1] The thesis examines how SIVAM provides a framework for greater cooperation in U.S. and Brazilian relations. The thesis also examines how SIVAM might leverage this cooperation in the area of Operations Other Than War (OOTW) in the greater Amazon region. From Brazil's vantage point, OOTWs might focus on such areas as ecological preservation, sustained development, border security, counter-drug missions, threats to indigenous populations, and social tension with the Landless Movement (*Movimento Sem Terra*- MST). [2] U.S. OOTW in the region might include environmental protection and counter-drug activities. SIVAM increases the linkages in the relations between United States and Brazil and this may be understood and analyzed under the framework of complex interdependence.

[1] Some interviews were conducted in Portuguese. See bibliography for a list.

A. OVERVIEW OF SIVAM

SIVAM is a technologically advanced command, control, coordination, communications, intelligence, surveillance and reconnaissance (C^4ISR) system.[3] The system relies primarily on an integrated aggregation of sensors and radars. SIVAM is valued at over one billion dollars and will be built primarily in northern Brazil. SIVAM's architecture is multi-facetted and it will produce a large amount of diffuse information in a timely manner. Consequently, SIVAM will generate a database from which customized reports can be generated to support the interests of a large number of government agencies. GOB has stressed that existing government entities and law enforcement agencies will respond to detected problems and illegal activities in the Brazilian Amazon once SIVAM becomes operational. This information may strain these agencies' ability to digest, let alone respond to, detected problems and illegal activities in the region. Further, the Brazilian Amazon represents over half of the Brazilian territory and thus logistics and communications are already areas of concern for Brazil.

Brazil's Aeronautics' Commission for Coordination (*Comissão para Coordenação do Projeto SIVAM*- CCSIVAM) is SIVAM's project manager. The Aeronautics technical arm, the Foundation for Application of Critical Technologies (*Fundacão Aplicações de Tecnologias Críticas*- ATECH) is providing engineering assistance. The U.S.-based Raytheon Corporation is the prime contractor for SIVAM. Brazil's former cabinet level ministry, Strategic Affairs Secretariat (*Secretaria de Assuntos Estratégicos*- SAE), was responsible for developing national strategy for the Brazilian President, such as the strategy for protection of the Amazon known as SIPAM. It also controlled SIVAM. The ministry's head, Ronaldo Sardenberg, had the responsibility for advising the President on national security issues, long-term strategic plans, space and nuclear policies, and the Amazon region.[4] However, the ministry's

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[2] Scott Tollefson, *Brazil: A Country Study*, ed. Rex A. Hudson (Washington D.C.: Library of Congress), 1998, 360.

[3] Tania Monteiro, "Projeto Cria Serviço Federal de Inteligência," *O Estado de São Paulo* [São Paulo] 20 September 1997, Available [Online]: <http://www.estado. com.br/jornal/97/09/20/news039.html> [21 October 1998].

[4] See <www.sae.gov.br>.

name changed in early-1999, and it was eliminated altogether in mid-1999. It was renamed from SAE to the Ministry of Special Projects *(Ministério Extraordinário de Projetos Especiais-* MEPE).[5] As MEPE is now dissolved, it now appears the Defense Ministry will predominantly assume control over SIVAM and SIPAM.[6] The Ministry of Science and Technology also assumed some of MEPE's functions.[7] Sardenberg recently became the new Minister of Science and Technology. Sardenberg believes that SIVAM will enable the full integration of Brazil's Amazon into the national community.[8]

SIVAM will be capable of performing multiple functions. MEPE advertised sustainable development and law enforcement as the two major foci of SIVAM. Sustainable development involves regional development balanced by the need for ecological preservation. Major law enforcement functions that SIVAM will support include counter-narcotics and border protection. For instance, Brazil's new defense minister, Élcio Álvares, stated in April 1999 that SIVAM will be crucial in identifying clandestine flights and drug trafficking organizations in the Amazon.[9]

---

[5] SAE and later MEPE developed SIPAM or System for Protection of the Amazon, to consolidate national control of the Amazon region and eliminate the perception that the region is a lawless frontier. According to *JDW*, SIVAM has the capacity to change the strategic balance of the region by giving Brazil greater military and political control of the Amazon region. "Brazil's Surveillance System Focuses on the Amazon," *Jane's Defense Weekly* 29, no. 11 (18 March 1998): 25.

[6] There are significant changes occurring in the Brazilian executive at the writing of this thesis as a result of the July 1999 cabinet reshuffle. Elaine Cantanhade and Carlos Eduado Lins da Silva, "FHC Yields Partially to Toucan Pressure on Changes," São Paulo FOLHA DE SÃO PAULO (17 July 1999), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 19 July 1999 (FTS19990719001549); Tania Monteiro and Edson Luiz, "Armed Forces High Command Meets to Coordinate SIVAM," São Paulo O ESTADO DE SÃO PAULO (4 September 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 8 September 1999 (FTS19990908000382). The article states the Defense Ministry is building the Manaus Regional Surveillance Center (CRV).

[7] David Fleischer, Political Science Professor, Interview by author 10 September 1999, Brasília, Brazil, University of Brasília. The author also met with Brazilian officers at the new Ministry of Defense who indicated SIVAM would probably fall under their purview.

[8] "Strategic Affairs Secretary Views Development," Rio de Janeiro O GLOBO (5 Nov 1996), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 13 November 1996 (FBIS-LAT-96-219).

[9] Aluizio Freire, "Minister Says More Military Officers Involved in Drug Trafficking," Rio de Janeiro JORNAL DO BRASIL (23 April 1999), Translation by the Foreign Broadcast Information Service, FBIS *Daily Report—Latin America:* 23 April 1999 (FTS19990426001301).

B. SIVAM AND COMPLEX INTERDEPENDENCE

The thesis will use international relations concepts to analyze U.S.-Brazilian relations. Keohane and Nye's theory of complex interdependence seems to provide a better framework than realism for understanding the impact of SIVAM on U.S.-Brazil relations. By realism, we mean the view that the state is the principal, unitary actor, and that national security and military issues are dominant. Keohane and Nye's theory describes the complex nature of international relations that encompasses more than the state and national security.[10] They assert that in many cases, complex interdependence better explains the reality of bilateral relations than realism.[11] They define *interdependence* as *mutual* dependence.[12] The theory states that multiple state and non-state actors, to include business and non-governmental organizations (NGOs), form relations between two countries. The theory asserts that traditional elements of realism such as state, military and national security issues in a balance of power framework do not present a complete picture of international relations.[13] Realism considers military security to dominate economic and social affairs. Complex interdependence better describes relations between some countries like the United States and Brazil, when military relations between two countries are not the most important links. Complex interdependence is characterized by:

1) Multiple channels connecting society– to include transnational organizations such as multinational banks and corporations.
2) Interstate relations involving multiple issues without a clear hierarchy, in which military security does not dominate. "Different issues generate different coalitions, both within governments and across them."

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[10] Robert O. Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition* (Boston: Little, Brown and Company, 1977), 22.
[11] Ibid.
[12] Ibid., p. 8.
[13] Ibid., p. 23.

3) Military force is not considered an option in the bilateral relations of both countries.[14]

Keohane and Nye state:

> The participation of large and dynamic organizations, not controlled entirely by governments, has become a normal part of foreign as well as domestic relations. These actors are important not only because of their activities in pursuit of their own interests, but also because they act as transmission belts, making government policies in various countries more sensitive to one another... Parallel developments in issues of environmental regulation and control over technology reinforce this trend.[15]

Keohane and Nye developed the theory to explain the various levels of complexity in the relationship between the United States and Canada, in particular. The theory can be applied to U.S. relations with Brazil as a result of Raytheon's participation in SIVAM (although U.S.-Canada relations are much more complex). This is because SIVAM, with its numerous state and non-state actors, increases the number of linkages between the two countries and places Brazil in a greater interdependent relationship with the United States than before. There are positive aspects of looking at U.S.-Brazilian relations from this theoretical framework. It is more representative of the mutual benefits that result from economic, corporate and environmental cooperation. According to Keohane and Nye, there is a greater perception of safety in this relationship— fears of attack are no longer a factor.[16] National security skepticism found in realism is replaced with an environment of greater trust and cooperation. Force is no longer relevant or important in this kind of relationship. Brazil can use its role as the more dependent actor in an interdependent relationship to bargain over issues such as combating drug trafficking or to affect other issues (see Chapter VI on improving SIVAM coverage cooperatively).[17] As a result of this relationship it is more likely that the United States and Brazil will cooperate with regional transnational problems such as drug trafficking

[14] Ibid., p. 24.
[15] Ibid., p. 26.
[16] Ibid., p. 27.
[17] Ibid., p. 11.

and guerrilla threats. The independent variable is U.S. involvement with SIVAM, and the dependent variable is the level of U.S.-Brazilian cooperation achieved.

C. RESEARCH QUESTIONS

The thesis seeks to answer certain issues. They are:

1) What military or OOTW applications does SIVAM possess? What capabilities of SIVAM could Brazil's military utilize for space and aerial collection (intelligence) in order to monitor and defend Brazil's borders?
2) What are the implications of SIVAM's capability to detect problems in the Amazon for military and police resources?
3) Will SIVAM capabilities result in Brazil requesting assistance from U.S. military, law enforcement and intelligence organizations? Would these U.S. agencies or entities respond? If so, would this result in a strengthening of bilateral linkages between the two nations?
4) Will U.S. involvement in support of SIVAM result in greater cooperation between the two countries in regional issues such as counter-drugs?

II. BRAZIL, THE UNITED STATES AND THE AMAZON

The Amazon region covers a huge land area. It is two-thirds the size of continental United States and encompasses 5.2 million square kilometers or 2 million square miles (see Figure 1).[1] Eight large Brazilian states are located in the Brazilian Amazon. They are Acre, Rondônia, Amazonas, Roraima, Amapá, Pará, Maranhão and Tocantins. The region has great potential for development, with estimates of mineral wealth alone valued at $30 trillion.[2] The region contains the largest tropical forest in the world. The forest is home to over half the animal and plant species known to exist worldwide. The Amazon River is 6,275 km (3,900 miles) long and is navigable for most its length. It carries a greater volume of water than any other river in the world. It flows from northern Peru, through the Brazilian Amazon, to the Atlantic Ocean. It is a region of great geo strategic importance to Brazil.

Figure 1. Brazilian Amazon Region and Continental United States After Commission for Coordination of SIVAM (CCSIVAM) briefing (1998).[3]

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[1] Thelma Krug, "Space Technology and Environmental Monitoring in Brazil," *Journal of International Affairs* 51, no. 2 (1998): 655-674.

[2] Alvaro de Souza Pinheiro, "A Vision of the Brazilian National Security Policy in the Amazon," *Low Intensity Conflict and Law Enforcement* 3, no. 3 (Winter 1994). Available [Online]: <http://call.army.mil/call/fmso/fmsopubs/issues /vision.htm> [14 October 1998].

A. BRAZILIAN INTERESTS IN THE AMAZON REGION

To Brazilians, the Amazon is more than just a large area in their country. The region symbolizes Brazil's strong nationalism and as such evokes many strong emotional connections. For instance, the region represents Brazil's undeveloped frontier mentality, a spirit similar to the "wild west" idealism present in 19th century America. Further, Brazilians of all classes see the Amazon, with its vast natural resources, as essential to their nation's future survival. Many Brazilians are instinctively suspicious of international interests in the region. They are aware of regional problems and that the inadequate political, economic and social control of the region creates a vulnerability. For example, over eighty percent of the region's airspace is not covered by air traffic control radars (ATC), and as a result a Varig airliner was lost in the jungle in 1995.[4] There is a general feeling that inadequate control of the borders and lack of development in the hinterlands could result in foreigners somehow taking over the region.

These concerns help explain in part the military's rush to develop the Brazilian Amazon during the military regime that lasted from 1964 until 1985 (See Chapter V, for more on military and the Amazon). It explains the Brazilian phrase "*integrar para não entegrar*" or integrate the region into Brazil to avoid having to hand it over to foreigners. Brazilians fear that they will lose the region if it remains underdeveloped. Many Brazilians feel foreigners have a strong sense of *cobiça*, or envy toward Brazil for possessing a vast resource wealth such as the Brazilian Amazon. This feeling helps explain Brazil's drive to achieve sufficient regional development to promote effective sovereignty. This sovereignty in part entails accessing areas of the region that lack river transportation, rail lines or roads, telephone or wireless communication, developing infrastructure in order to support military presence, as well as building centers of habitation for Brazil's citizens. (Chapter III discusses how SIVAM's architecture will bring infrastructure into remote areas and villages).

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[3] Colonel Francisco Leite de Albuquerque Neto, FAB, telephone interview by author, 11 September 1998 and Interview by author, 24-26 March 1999 Dallas, TX and Wobrun, MA, Comissão para Coordenação do Projeto SIVAM (CCSIVAM).

[4] "Brazil Traffic Control," *Economist,* 25 November 1995, Available [Online]: <http://proquest.umi.com> [13 September 1998]; Interview with Albuquerque Neto.

Brazil has a strong sense of sovereignty that fuels its drive to control the Brazilian Amazon. It looks at foreign interests in the region with suspicion. For example, Brazilians are suspicious that some members of NGOs are geological engineers working for foreign oil and mining companies. Brazilians are especially skeptical of the United States, the European Union and the United Nations. They look at world concern for the environmental degradation in the Amazon as a threat to Brazil's sovereignty because of the possibility of intervention. The military is particularly sensitive to foreign interest (see Chapter VI). An expert on Brazil and NGOs asserts that NGOs often contest the traditional concept of sovereignty in the Amazon and have influence over international governments to enact legislation supporting their cause.[5] Further, they believe that whenever Brasília accepts international donor aid to support indigenous causes, national sovereignty is decreased.[6] Finally, world population growth will eventually increase pressure on the right of Brazilian sovereignty over the Amazon. These views were well received, for example, at the military-backed Brazilian Center for Strategic Studies (*Centro Brasiliero de Estudos Estratégicos*- CEBRES) in 1996. Brazilian congressman José Genoino of the left wing Workers' Party (*Partido dos Trabalhadores*- PT) asserts that Brazil is struggling with defining a new national security strategy for the defense of the Amazon, particularly with the end of the cold war.[7] Brazilian national security policy is driven by geography. According to Colonel Alvaro de Souza Pinheiro of the Brazilian army:

> The incalculable resources of the Brazilian Amazon have been coveted by many for a long time. There have been many international pressures on the area, including incursions by foreign powers starting as early as the seventeenth century. Brazil has resisted threats to its sovereignty over the Amazonia *as well as other attempts by international organizations to interfere in its affairs*. There are now serious challenges to be

[5] Lydia Garner, "A Amazonia e os Interesses Estrangeiros," *Cadernos de Estudos Estratégicos (CEBRES)*, no. 3 (March 1996): 19-20.
[6] Ibid., 24.
[7] José Genoino, "Política Militar e Desmilitarização de Servicos," *O Estado de São Paulo* [São Paulo] 7 February 1998, Available [Online]: <http://www.estado. com.br/jornal/98/02/07/news271.html> [21 October 1998].

overcome as Brazil pursues settlement and development of the Amazon [emphasis added].[8]

Colonel Souza Pinheiro emphasizes the Amazon's geopolitical importance, and how it is an important element in the equation of development to support the growth of 3.4 million jobs a year.[9]

The Brazilian government is aware of the destabilizing impact of activities related to drug trafficking such as money laundering and drug consumption.[10] The Brazilian government has begun to publicly admit to failed counter-drug measures in the region. The former superintendent of the Federal Police in the Amazon, Mauro Sposito, testified to Brazil's Congress at the Parliamentary Investigation Commission (*Comissão Parlamentar de Inquérito*- CPI) on 11 May 1999 that in his view the borders in the region are porous and unguarded, and that there are only fifteen police officers present to combat drug trafficking in the region.[11] Sposito stated that it was impossible to inspect the 740 registered small landing fields, as his force had no helicopters or airplanes.[12]

In the past year, the Brazilian government began taking significant actions to address the drug problem. It this effort, Judge Walter Maierovitch became the nation's first anti-drug czar in 1998. He is a cabinet level secretary with direct access to the president. He heads the Anti-Drug Secretariat (*Secretaria Nacional Anti-Drogas*- SENAD), which was formed in June 1998 and began operating in November of that year for coordination, prevention and interdiction of drugs.[13] SENAD works in coordination with the National Anti-Drug System (*Sistema Nacional Antidrogas*- SISNAD), headed by General Alberto Cardoso, to combat drugs in Brazil. In April 1999, Maierovitch stated

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[8]Álvaro de Souza Pinheiro, "A Vision of the Brazilian National Security Policy in the Amazon," *Low Intensity Conflict and Law Enforcement* 3, no. 3 (Winter 1994). Available [Online]: <http://call.army.mil/call/fmso/fmsopubs/issues /vision.htm> [14 October 1998].

[9] Ibid.

[10] Mora.

[11] Jailton de Carvalho, "Tráfico Livre na Amazonia," *Jornal do Brasil* [Rio de Janeiro] 12 May 1999, Available [Online]: <http://www.jb.com.br> [12 May 1999].

[12] Ibid.

[13] Ismar Cardona, "Drug Czar Says DEA Must 'Abide By Our Rules,'" São Paulo GAZETA MERCANTIL (6 April 1999), Translation by the Foreign Broadcast Information Service, FBIS *Daily Report—Latin America;* 6 April 1999 (FTS19990406001207), Lauro Rutkowski, "Profile, Goals of New Drug Czar Detailed," Brasília CORREIO BRAZILIENSE (12 July 1998), Translation by the Foreign Broadcast Information Service, FBIS *Daily Report—Latin America;* 14 July 1998 (FTS19980714000393).

that the drug-related "economy of around four percent of the world's GDP has an unimaginable corruption power."[14]

The transnational drug problem has acted as a catalyst for regional cooperation. The Organization of the Amazon Cooperation Treaty (OTAC) was formed in October 1998 as a direct response to the need for greater regional coordination.[15] The Foreign Ministers of Brazil, Bolivia, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela formed OTAC by signing an amendment to the 1978 Amazon Cooperation Treaty (TCA).[16] OTAC will have a permanent secretariat in Brasília in 1999. OTAC provides Brazil a tool for leadership on regional issues such as the Amazon. According to the Brazilian foreign ministry (*Itamaraty*) chief of the South American Division, Fernando Jacques Pimenta,

> Our idea is to send a political signal about the growing importance of the Amazon region for our governments. With the strengthened structure, OTAC will be better able to dialogue with the governments of other countries and international bodies to raise funding.[17]

Itamaraty states that OTAC will coordinate international aid to the region.[18] OTAC creates a coordinated response mechanism for regional problems. It is a forum by which regional foreign ministers can discuss transnational problems in the Amazon such as drug trafficking, or guerrilla activity. In December 1997, Minister Sardenberg stated that Brazil would work to gain support from its neighboring countries for SIVAM.[19] Brazil has also approached Colombia and Peru concerning the feasibility of establishing systems similar to SIVAM.[20]

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[14] Paulo Mussoi, "Government to Create Mechanism to Monitor Drug Czar's Worth," Rio de Janeiro JORNAL DO BRASIL (3 April 1999). Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 6 April 1999 (FTS19990406000755).

[15] "Amazon Cooperation Organization Formed," Brasilia CORREIO BRAZILIENSE (6 October 1998), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 8 October 1998 (FTS19981008001026).

[16] Ibid.

[17] Ibid.

[18] Ibid.

[19] "Brazil to Seek Support of Neighboring Countries for Amazon Surveillance System," *Agencia Estado News Agency* [São Paulo] provided by BBC Monitoring Service, 8 December 1997. Available [Online]: <http://infoweb.newsbank.com> [17 November 1998].

[20] Edson Luiz, "SIVAM Entra em Operação no Próximo Ano," *O Estado de São Paulo* [São Paulo] 20 July 1999, Available [Online]: <http://www.estado. com.br/search/form-jornal.html> [22 July 1999].

In summary, the major concerns of Brazilians in the Amazon region are fueled by its strong sense of sovereignty and need to maintain control of the region. These concerns are 1) providing sufficient development for effective regional integration and control; 2) controlling border incursions by drug traffickers and guerrillas; 3) combatting illegal mining and deforestation; and 4) avoiding general ecological degradation.

B. PROBLEM AREAS AND ILLEGAL ACTIVITIES IN THE REGION

The region is plagued with diverse environmental and law enforcement problems.[21] Most are difficult to resolve and are becoming more serious.

1. Law Enforcement

Major law enforcement areas of concern can be classified into border incursions (by drug traffickers and guerrillas), illegal logging and mining, mineral smuggling, and social instability caused by land disputes.

Incidents of border incursions by drug traffickers and guerrillas from neighboring countries are rising.[22] According to a report by the Federal Police, "16,000 km of land frontier are in the hands of organized crime."[23] A large portion of the drugs are smuggled by air. Estimates of the number of illegal flights vary because only ten percent of the Amazon's airspace is currently monitored by five radars.[24] Over twenty flights a day are made between Peru and Colombia, some through Brazilian airspace.[25] Light aircraft depart Peru with cocaine paste, stop in the Brazilian Amazon for refueling and proceed to

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[21] Anthony Faiola, "Amazon Going Up in Flames; Blazes Ravaging Precious Brazilian Rain Forest." *Washington Post,* 27 March 1998, Available [Lexis/Nexis]: REGNWS/CURNWS [4 August 1998].
[22] "Police Complain of Lack of Resources," *Latin American Regional Reports,* no. 6 (1997): 6.
[23] Ibid.
[24] Lauro Rutkowski, "SIVAM Seen Crucial for Drug Traffic Control," Brasilia CORREIO BRAZILIENSE (10 February 1998), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 12 February 1998 (FBIS-LAT-98-041); "SIVAM Seen Crucial for Drug Traffic Control," Brasilia CORREIO BRAZILIENSE (10 February 1998). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 12 February 1998 (FBIS-LAT-98-041).
[25] "Traffickers' Use of Amazon Airspace," Brasilia CORREIO BRAZILIENSE (8 Jun 1997). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 17 June 1997 (FBIS-LAT-97-115).

Colombia for delivery to Colombian processing laboratories. The smugglers avoid radar bases in Peru and Colombia by transiting through the Brazilian states of Acre and Amazonas. According to Brazil's Federal Police, 2,760 flights, with a capacity of 300 kilograms each, are required to transship the Peruvian Andes' yearly production of coca.[26] The Brazilian Air Force (*Força Aérea Brasileira*- FAB) estimates about 1,440 drug smuggling flights a year travel through Brazil, carrying an estimated eight percent of the cocaine produced in Peru, Colombia, and Bolivia. The former superintendent of the Federal Police, Vicente Chelotti testified before a congressional investigation on drug activities (*Comissão Parlamentar de Inquérito*- CPI) in May 1999 that 2,300 small aircraft flights carry four hundred tons of cocaine paste through the Amazon each year. He emphasized there is a lack of police resources to combat this problem.[27] The exact number of smugglers is not known due to lack of aerial surveillance, but it is probably somewhere between the FAB and Federal Police estimates. Most of their cargo ends up in Europe and the United States.[28]

Smugglers are aware that the FAB is currently not authorized to shoot down non-cooperative aircraft.[29] In March 1998, Brazil's Congress passed a law authorizing FAB to shoot down non-cooperative civilian aircraft.[30] However, the law is currently not in effect due to difficulties in defining shoot-down procedures.

Drug trafficking through the Brazilian Amazon has increased due to greater enforcement in neighboring countries. U.S.-supported Peruvian and Colombian counter-drug efforts have, "...indirectly and unwittingly contributed to pushing the drug trade away from the Andean region and toward Brazil and the Southern Cone."[31] Frank O. Mora of Rhodes College in Memphis calls this the "Balloon Effect." Improved aerial and other interdiction on the Peru-Colombia axis has resulted in the branching out of cocaine

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[26] Ibid.
[27] Hugo Marques.
[28] Ibid.
[29] Ibid.
[30] Schomberg, William. "Brazil Ready to Shoot Down Drug Planes," *Reuters,* 5 March 1998, Available [Online]: <http://infoweb.newsbank.com> [17 November 1998]; Interview with Albuquerque Neto.
[31] Frank O. Mora, "Victims of the Balloon Effect: Drug Trafficking and U.S. Policy in Brazil and the Southern Cone of Latin America," *Journal of Social, Political and Economic Studies* 21, no. 2 (1996): 115.

trafficking through Bolivia and Brazil.[32] According to U.S. State Department's 1998 Narcotics Control Strategy Report, "In recent years, Brazil's vast western region has been used by narcotics traffickers to sustain an "airbridge" to avoid the airspace in Peru and Colombia, which maintain active aerial interdiction policies."[33] In a recent visit to South America, Office of National Drug Control Policy Director Barry McCaffrey stated that drug producers are finding new routes through Brazil and Argentina.[34] According to the influential Brazilian weekly news magazine *Veja*, Federal Police have information about drug traffickers' hideouts in the Amazon forests, but are unable to locate them.[35] Drugs are also produced in makeshift laboratories in the Brazilian Amazon.[36] This activity transgresses Brazilian sovereignty. According to U.S. Navy Captain George Satterthwaite, former Defense Attaché in Peru, Brazil has been generally unsuccessful in stopping drugs being transported down the Amazon River from Peru.[37]

The Cali cartel has moved some of its illegal operations to Brazil.[38] The Brazilian state of Rondônia borders Bolivia and has received the nickname of "Rondônia Cartel".[39] Rondônia is a microcosm of Brazil in that it "...has an ineffectual judicial system, poorly equipped and manned police to guard its vast and remote border, and inadequate laws to deal with the surging problem."[40]

Colombian and Peruvian guerrillas are increasingly active in the relative security of the Brazilian Amazon. Narco-guerrillas are emerging in greater numbers in the same area. Chapter V describes the military's role in combating guerrilla threats to Brazil.

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[32] Ibid.
[33] U.S. State Department, *1998 International Narcotics Control Report*, Bureau for International Narcotics and Law Enforcement Affairs, Washington D.C., February 1999, Available [Online]: <http://www.state.gov/www/global/narcotics_law/1998_narc_report/samer98_part2.html>.
24 September 1999.
[34] Stephen Brown, "McCaffrey Says Drugs Taking New Latam Routes," *Reuters*, 27 August 1999. Available [Online]: <www.reuters.com> [24 September 1999].
[35] "Importance of SIVAM for Amazon Considered," São Paulo VEJA (29 December 1997). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 31 December 1997 (FBIS-LAT-97-363).
[36] Alvaro de Souza Pinheiro, "A Vision of the Brazilian National Security Policy in the Amazon," *Low Intensity Conflict and Law Enforcement* 3, no. 3 (Winter 1994). Available [Online]: <http://call.army.mil/call/fmso/fmsopubs/issues /vision.htm> [14 October 1998].
[37] George Satterthwaite, Captain USN, Defense Attaché Officer, Interview by author, 25 November 1998, Naval Postgraduate School, Monterey CA, U.S. Embassy Peru, Lima.
[38] Ibid.
[39] Ibid.
[40] Ibid.

Illegal logging (*desmatamento)* is growing due to increasing demand for timber worldwide. According to government estimates, eighty percent of the harvested timber in the Amazon is illegally extracted.[41] According to *Veja*, there are twenty-two major foreign timber companies in the Amazon region that produce five times more timber than the maximum permitted from logging concessions.[42] The largest is the Malaysian company WTK, which began operating in Brazil in 1994 after purchasing one of several bankrupt timber companies and sawmills in Manaus.[43] According to World Watch, the amount of forest under concession to Asian companies quadrupled in 1996, and several of these companies are illegally extracting more timber than allowed by concession.[44]

The Brazilian Institute for the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis-* IBAMA*)* was created in 1989 to protect fauna and flora.[45] Consequently, IBAMA is responsible for regulating the logging industry, however in 1996 some inspectors were receiving payoffs equivalent to 40,000 U.S. dollars for a license to cut protected mahogany.[46] According to *Veja*, "the federal government has made almost no effort to prevent deforestation of the Amazon region."[47] *Veja* criticizes the shortage of inspectors in the vast area and describes "too much talk (*muita fala)*" and a lack of action in Brasília. For example, IBAMA has only sixty-two inspectors in the state of Amazonas, although six out of every ten houses have wild animals in captivity.[48]

According to a sawmill manager in Paragominas, "no one takes notice of government regulations that restrict logging."[49] The few officials that do are easily

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[41] Daniel Litvin, "Survey: Development and the Environment: Stumped By Trees," *Economist,* 21 March 1998. Available [Online]: <http://proquest.umi.com> [10 August 1998].
[42] "Asian Loggers Arrive in Force," *Latin American Regional Reports,* no. 7 (1998): 3.
[43] Ibid.
[44] Danielle Knight. "Environment: Global Forest Crises Accelerating." *Inter Press Service,* 4 April 1998, Available [Online]: <http://infoweb.newsbank.com> [27 July 1998].
[45] "Ibama's Deficiencies Decried," São Paulo O ESTADO DE SÃO PAULO (30 August 1996). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America:* 27 September 1996 (FBIS-LAT-96-188).
[46] Ibid.
[47] Leonel Rocha, "Importance of SIVAM for Amazon Considered," São Paulo VEJA (29 December 1997). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America:* 31 December 1997 (FBIS-LAT-97-363).
[48] Howard LaFranchi, "On the River With the Eco-Police," *Christian Science Monitor,* 14 May 1997. Available [Online]: <http://www.csmonitor.com/cgi-bin> [3 August 1998].
[49] Daniel Litvin.

bribed. IBAMA collected only six percent of fines levied in 1997.[50] According to *The Economist*, commercial logging is a big cause of deforestation and will grow, as the global annual demand for industrial timber is projected to increase from 1.3 billion cubic meters in 1995 to 1.9 billion cubic meters in 2010.[51] Evidence of this alarming trend is validated by the United Nations (UN) Food and Agriculture Organization, which has documented the fact that in the last 35 years, world timber consumption doubled, and paper consumption tripled.[52] In sum, the government has had difficulty limiting destruction of the Amazon forest due to lack of inspectors and world demand for timber.

Much of the mineral mining in the Brazilian Amazon is not only illegal, but also harmful to the environment. In particular, gold mining results in large amounts of mercury being dumped in the rivers due to the very nature of the separation process. According to the *Nation*, in 1990 40,000 gold miners threatened the 9,000 protected Ianomami Indians by disturbing their delicate habitat.[53] The Ianomami is the last stone-age tribe to be found in the Amazon region. They live in a large reservation in the states of Roraima and Amazonas and have had contact with civilization only since the 1970s.[54] Miners illegally use landing strips that the military built for *Calha Norte* to smuggle minerals out of the region (see Chapter V for more on *Calha Norte*). Large logging interests, local developers and the governor of Roraima all support the miners.[55]

Social problems have resulted from excessive development. Landowners support development because they profit. According to *Veja*, a hectare of virgin forest costs as little as eight dollars. The price rises to twenty dollars close to roads or rivers.[56] Beginning with the military government of General Medici in 1970, Brazil encouraged immigration into the region and unchecked development resulted. This policy continued until the early 1990s.[57] The military saw populating the region as a way of preserving

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[50] Ibid.
[51] Ibid.
[52] Danielle Knight.
[53] Linda Rabben, "Brazil's Military Stakes its Claim," *Nation*, 12 March 1990: 341-432. Available [Online]: <http://proquest.umi.com> [10 August 1998].
[54] Anthony Faiola.
[55] Ibid.
[56] "Asian Loggers Arrive in Force."
[57] Alex Bellos, "Politics Among Villains in Amazon Forest Fires," *Orange County Register*, 26 March 1998, Available [Lexis/Nexis]: REGNWS/CURNWS [4 August 1998].

national sovereignty. Serious social problems arose due to rapid development in the Amazon. These social problems present law enforcement challenges. For example, land disputes between large landowners and peasant farmers as well as members of the Landless Movement (*Movimento Sem-Terra*-MST) are common. From 1993 to 1998, MST leaders encouraged the poor and the landless to squat on over four million square kilometers nationwide.[58] The MST has at least one heavily armed cell and is perceived by the federal government to be a significant threat to internal politics and stability in the Amazon.[59] For example, President Cardoso sent the army into the Brazilian state of Pará in 1998 to decrease tensions between landowners and MST squatters (see Chapter V).[60] Squatters, Indians, and loggers also enter into conflicts because of confusion resulting from inaccurate and false land titles. A significant cause underlying these disputes occurs because a number of land owners/users fail to register their properties in order to avoid logging restrictions.

2. Ecological Degradation

Ecological degradation primarily results from agricultural and cattle production slash and burn deforestation, uncontrolled wild fires, and natural resource exploitation. In November 1997, President Fernando Henrique Cardoso announced an environmental policy change by focusing on sustained exploitation as opposed to radical preservation.[61]

Human activity in the Amazon is degrading its ecology. According to analysis conducted by Brazil's National Institute of Space Research (*Instituto Nacional de Pesquisas Espaciais*- INPE) of 200 U.S. LANDSAT images from 1996, a total of ten to twelve percent[62] of the Amazon region has been destroyed by logging, burning and other

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[58] Amaranta Wright, "Squatters' Army Sees Rich Reaching for Guns," *Scotsman* [Scotland], 17 May 1998. Available [Lexis/Nexis]: WORLD/ALLNWS [4 August 1998].

[59] "Brazilian Peasants Movement Arms Itself—Resumes Land Seizures," *Global Intelligence Update*, 17 September 1998, Available [Online]: <http://www.stratfor.com> [16 September 1998].

[60] Amaranta Wright.

[61] "Sustainable Development New Amazon Policy," São Paulo O JORNAL DA TARDE (30 November 1997), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 2 December 1997 (FTS19971202000520).

[62] James Craig, "Ravaging of Brazil's Amazon Continues – Survey." *Reuters,* 26 July 1998. Available [Online]: <http://infoweb.newsbank.com> [27 July 1998]. Also see Thelma Krug, "Space Technology and Environmental Monitoring in Brazil." *Journal of International Affairs* 51, no. 2 (1998): 655.

human encroachment, most of it in the last 15 years.[63] Many large cattle ranchers defy laws prohibiting clear cutting, resulting in excessive deforestation. In 1999, IBAMA used LANDSAT imagery and Global Positioning System (GPS) equipment to locate the top ten ranches with the most deforestation from clear cutting in the region.[64] According to Jose Goldenberg, of the University of São Paulo (USP), "If something bold is not done to prevent the kind of massive destruction we are seeing in Roraima, we will have a desert in the Amazon in 40 or 50 years."[65] Figure 2 depicts the rate of deforestation since 1989.

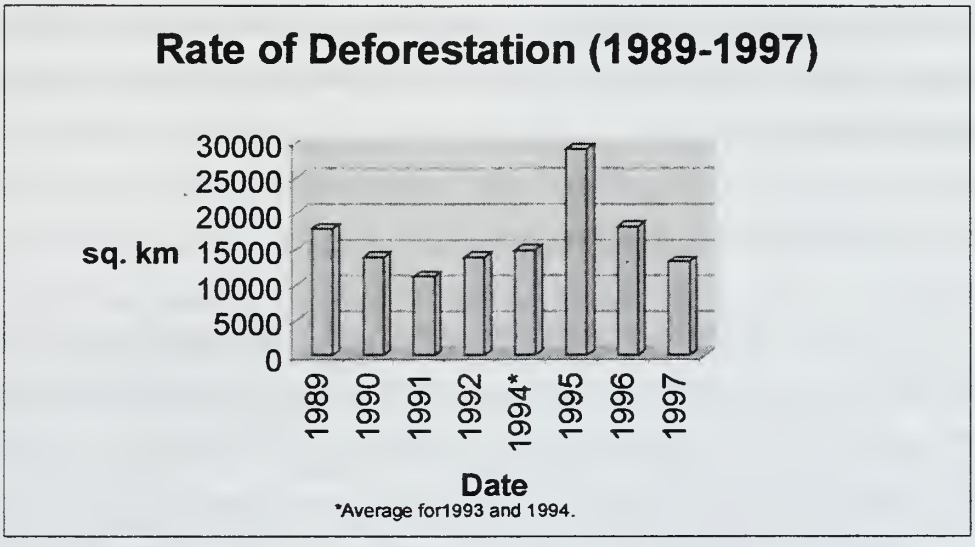

Figure 2. Amazon Deforestation
From Instituto Nacional de Pesquisas Espaciais (INPE).66

As a result of excessive slash and burn for agricultural and cattle production, 1998 was the worst year for rainforest fires in the Amazon on record. According to the federal government, large fires in Roraima burned an estimated twenty percent of the state in that year (see Figure 3).[67] The *El Nino* weather phenomenon was partly to blame, as well as dry forests in the periphery of developed areas. The fires were sparked by slash and burn

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[63] "Fires Devastate Amazon Rain Forest; Recovery, if it Occurs, Could Take a Century."
[64] Klester Cavalcanti and Alexandre Mansur, "Carrascos da Mata," *Veja* (Brazil), 7 April 1999, 109-115.
[65] Anthony Faiola.
[66] Klester Cavalcanti, 111.
[67] "Fires Devastate Amazon Rain Forest; Recovery, if it Occurs, Could Take a Century," *The (Baltimore) Sun,* 12 April 1998, Available [Lexis/Nexis]: REGNWS/CURNWS [4 August 1998].

agriculture in those developed areas in the Amazon. Unlike the savanna flora that quickly recovers from burning, the rainforest requires over one hundred years to recover, and is not normally subject to burns.[68] Despite the government ban on lighting fires in Roraima in March 1998, aerial observers witnessed many slash and burn farmers ignoring this ban in order to continue their activities. According to Philip Fearnside of the independent National Institute for Amazonian Research, burning is required by peasant farmers to decrease soil acid and allow the weak soil to support agriculture.[69] Leaching the soil by burning it also destroys surrounding rainforest as it dries.

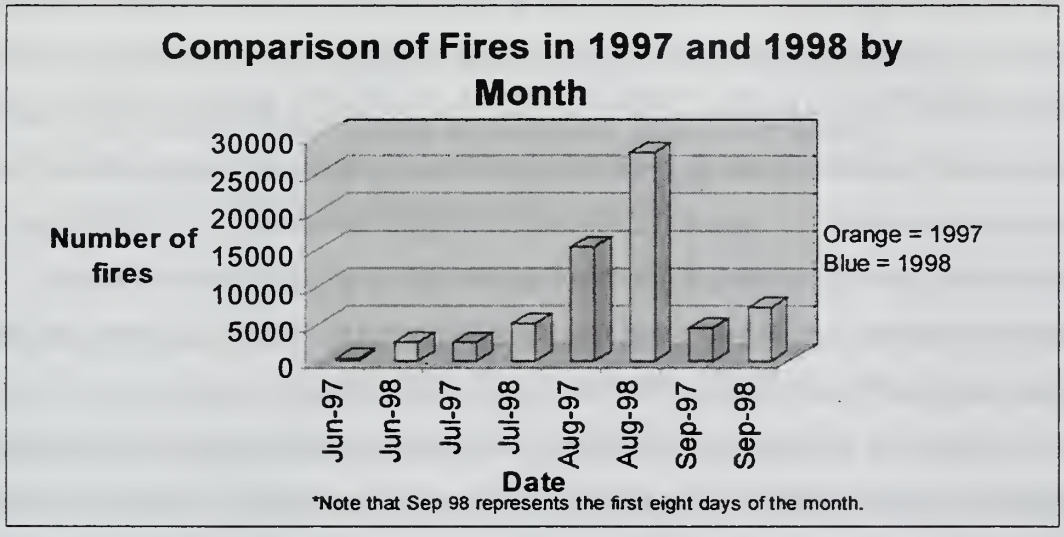

Figure 3. Comparison of Major Fires in the Amazon From NOAA 12 Weather Satellite [70]

C. U.S.- BRAZILIAN BILATERAL RELATIONS

Multiple channels of interaction, or linkages form relations between Brazil and the United States, although not to the same degree as United States and Mexico or Canada.[71] Relations are primarily centered on commercial interaction and trade. Neo-

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[68] Alex Bellos.
[69] Ibid.
[70] "Burning Up Again in Brazilian Amazon," *Environmental Defense Fund,* 16 September 1998, Available [Online]: <kenneth_walsh@edf.org> [18 September 1998].
[71] Abraham F. Lowenthal, *Partners in Conflict: The United States and Latin America in the 1990s.* Baltimore: Johns Hopkins University Press, 1990, p. 113.

liberal reforms such as privatization of state owned industries and opening of markets began with President Fernando Collor de Mello (1990-1992) and continue with Fernando Henrique Cardoso (1994-present). These reforms have increased economic interaction between Brazil and the United States. Brazil also maintains strong economic ties with Western Europe and Japan, as well. Brazil joined international non-proliferation regimes such as the Missile Technical Control Regime (MTCR) in 1995 and Nuclear Non-Proliferation Treaty (NPT) in 1998. It seeks a permanent seat in an expanded United Nations Security Council, presumably after Japan and Germany.

Brazil considers itself to be a regional power in Latin America, and is sensitive to U.S. policy in the region, especially when Brasília is not consulted. There has been significant regional cooperation, especially with Southern American Common Market (MERCOSUL) and Argentina. There is tension with the U.S.-led effort to expand the North American Free Trade Agreement (NAFTA), especially with Chile. Brazil has sought to slow NAFTA expansion, beyond its original membership of the United States, Canada and Mexico. MERCOSUL is composed of the original members Brazil, Argentina, Uruguay, and Paraguay. Chile and Bolivia have joined as associate members. Brazil sees NAFTA as a form of U.S. economic domination.

The U.S. is focused on increasing Brazilian support for counter-drug efforts, especially with the Balloon Effect in the Brazilian Amazon region. It seeks military and law enforcement cooperation. This is especially critical to the United States with the closing of Panamanian bases, and the need to support new bases in the South America and Caribbean (e.g., Aruba, Ecuador) for U.S. counter-drug efforts. Brazil has been slow to cooperate with U.S. efforts to coordinate counter-drug efforts in the region. Unlike many Latin American countries, it has not accepted U.S. aid or military support for this effort. Brazil's strong sense of sovereignty is probably the single greatest obstacle to increased cooperation between the United States and Brazil in regional matters.

The U.S. *Secretary of Defense 1997 Annual Report to the President and Congress* states the primary objectives of the United States in the Western Hemisphere are regional stability and cooperation. These objectives also apply to the Amazon region. The report states "the United States also has a key interest in countering the steady flow of narcotics

into the United States from source countries in Latin America and the Caribbean."[72] The Western Hemispheric Drug Elimination Act of 1998, also supports this interest.[73]

The United States is also concerned with environmental protection. In 1990, President George Bush announced the Enterprise for the Americas Initiative (EAI), which included not only the promotion of anti-drug cooperation, but also environmental protection.[74] Interest for EAI continued in March 1998 by the U.S. House of Representatives, where the International Relations committee proposed H.R. 2870, the Tropical Forest Protection Bill. It was signed into law as the Tropical Forest Conservation Act of 1998.[75] According to New York Representative and committee chairman Ben Gillman:

> This bill stems directly from President Bush's Enterprise for the America's Initiative (EAI), to accomplish the twin goals of relieving Latin America's debt burden to the United States while making investments in conservation and tropical forest protection. It has come to be known as swapping debt-for-nature.[76]

According to William W. Mendel, of the Foreign Military Studies Office in Fort Leavenworth, only recently has the United States leadership begun to emphasize what he terms "gray area phenomena" as threats to national security.[77] He defines gray area phenomena as drug trafficking, insurgency, smuggling, lawlessness, poverty, and refugee flows. President Clinton's national strategy of Engagement and Enlargement calls for combating gray area threats:

> Transnational phenomena such as terrorism, narcotics trafficking, *environmental* degradation, natural resource depletion, rapid population growth and refugee flows also have security implications for both present and long term American policy. In addition, an emerging class

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[72] William Cohen, "Annual Report to the President and the Congress," Department of Defense, April 1997.
[73] Congress, House, *Western Hemisphere Drug Elimination Act of*, 105th Cong., H.R. 4300. *Congressional Record,* 16 September 1998, Available [Online]: <http://thomas.loc.gov> 18 May 1999.
[74] Scott Tollefson, "U.S. Policy Toward Latin America: An Historical Overview," TMs.
[75] See <http://thomas.loc.gov>.
[76] Benjamin Gillman, "H.R. 2870, The Tropical Forest Protection Act," *Committee on International Relations House of Representatives: 105th Congress 2nd Session,* 4 March 1998, Available [Online]: < http://commdocs.house.gov/committees/intlrel/hfa48783.000/hfa48783_0.htm> [2 December 1998].
[77] William W. Mendel, "Significance of Brazilian Strategic Thinking," *Foreign Military Studies Office Publication,* July 1995. Available [Online]: <http://call.army.mil /call/fmso/fmsopubs/ issues/amazon/amazon.htm> [14 October 1998].

> of *transnational environmental issues* are increasingly affecting international stability and consequently will represent new challenges to U.S. security [emphasis added].[78]

Drug trafficking and environmental degradation from forest fires and illegal activities in the Amazon are transnational phenomena of greatest concern to the United States.

In summary, the major interests of the United States in the Amazon region are 1) denying drug trafficking transit through the region through cooperation; 2) stemming regional ecological degradation and; 3) encouraging Brazil to manage development in the Amazon so that it is less harmful to the environment.

D. MUTUAL INTERESTS AND COOPERATION

Traditionally, there has been limited cooperation between Brazil and the United States on regional issues. Military-to-military cooperation exists with UNITAS, where U.S. naval forces operate with the armed forces of Brazil and other South American countries once a year.[79] Cooperation also occurs during OPERATION SAFE BORDER with the Military Observer Mission Equador/Peru (MOMEP) where Brazil and the United States were two of the four signatories guaranteeing arbitration of Peru and Equador's borders in 1999. Increased economic activity and the democratization of the Brazilian government have not resulted in increased cooperation in areas such as counter-drug efforts. Brazil has not accepted direct aid toward this effort. In contrast, Colombia, Peru, and Bolivia have all received substantial U.S. aid for counter-drug programs. Brazil has resisted militarizing the fight against drugs, despite the lack of operational success by the Federal Police in this problem area.

There are a few impediments to U.S.-Brazil cooperation. Impediments are exacerbated by Brazil's strong sense of sovereignty, and its long-standing distrust of U.S. (and other foreign) interests in the region. U.S. based non-governmental organization

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[78] *National Security Strategy of Engagement and Enlargement* (Washington, D.C.: Government Printing Office, February, 1995). Also see *A National Security Strategy for a New Century* (Washington, D.C.: Government Printing Office, October, 1998), p. 6.

[79] Margaret Daly Hayes, Richard D. Kohout, Patrick H. Roth, Gary F. Wheatley, *Future Naval Cooperation With Latin America: Final Report.* Alexandria, Virginia: Center for Naval Analysis, 1995, 45.

(NGO) activity especially in ecological preservation has fueled a suspicion that Americans may try to force their ecological agenda on Brazil. Another impediment is the belief that the U.S. has economic interests in the region, especially with its vast resources. Brazil is suspicious of U.S. counter-drug efforts in the region, believing that it should control drug consumption at home rather than force the Brazilian military to get involved in law enforcement.

Yet there are overlapping interests between the two countries, such as controlling drug and other illegal activity that is destructive to the region. As we shall see in Chapter VI, it is possible that SIVAM will provide a venue for greater bilateral U.S.-Brazil cooperation serving the interests of both countries. Given Brazil's strong sense of sovereignty concerns, it is significant that the U.S. has "put its foot in the door" in participating in SIVAM, a project closely tied to sovereignty issues. SIVAM is also strategically important to both countries because of its capabilities to monitor and interdict drug smuggling and detect guerrilla activity. If the Brazilians see Raytheon's participation in SIVAM as being successful, it could melt the ice of resistance toward the United States, and open doors for cooperation in the Amazon. SIVAM, especially with U.S. cooperation, could give Brazil the tool to be a leader in regional issues.

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III. SIVAM DEVELOPMENT, ARCHITECTURE AND U.S. INVOLVEMENT

The scale and technical complexity of SIVAM's architecture encourage significant interaction and cooperation between the United States and Brazil. This chapter will describe how U.S. government involvement with SIVAM became significant as early as the bidding and contracting processes. The chapter will analyze SIVAM's complex architecture and organization as well as its significant capabilities to satisfy diverse demands meted out by the Brazilian government in support of its geopolitical goals of development and control of the Brazilian Amazon. Chapter IV will examine some limitations in this architecture. U. S. government involvement directly and through Raytheon Corporation in this process provides greater linkages between both countries.

The international relations theory of complex interdependence helps one frame SIVAM as a significant project that brings together many state and non-state actors in the U.S. relationship with Brazil. The result will be a more complex relationship.[1] This relationship may intensify as Brazil employs SIVAM and tackles regional problems such as counter-drug operations.

A. SIVAM CONTRACT HISTORY AND U.S. GOVERNMENT INVOLVEMENT

SIVAM began linking many state and non-state actors in the United States and Brazil before bidding and contracting for SIVAM had commenced. Multiple U.S. executive agencies, the U.S. ambassador to Brazil, and the U.S. President actively supported Raytheon's bid (see the Appendix for government documents relating to this effort). This form of active diplomacy is reminiscent of actions by President Howard Taft and Secretary of State Philander C. Knox to promote American business interests in

[1] Robert O. Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition,* Boston: Little, Brown and Company, 1977, p. 26.

Latin America and abroad in the period of 1909-13. Knox believed in the slogan "Every diplomat is a salesman."[2]

The United States government intervened politically to ensure Raytheon did not lose the SIVAM contract to the French firm Thomson CSF. Political opposition, accusations of corruption and influence pedaling in Brazil resulted in delays, but did not stop the project. If recent history is an indication, U.S. influence in support of SIVAM will continue in the near future.

B. SIVAM BIDDING PROCESS

Raytheon won the bid but the execution of the SIVAM contract was delayed because of accusations of improprieties in Brazil. In his research using documents and interviews, the author found no evidence of improprieties in the part of Raytheon. Obstacles to Raytheon winning the SIVAM contract began in 1993 and involved international, diplomatic, political and legal actors.

The Brazilian military received presidential approval for SIVAM in 1993. In August 1993, President Itamar Franco decided the bidding process would not be public, following the recommendation of the National Defense Council (*Conselho de Defesa Nacional*- CDN). SIVAM's technical specifications were protected for national security reasons.[3] That same month, a commission was created, consisting of ninety experts from organizations such as the central bank, federal police, Strategic Affairs Secretariat (SAE), the Ministries of Aeronautics, Justice, Agriculture, Navy, Army, and Environment.[4] Their job was to select the best proposal. SAE, a cabinet-level agency, initially managed the bidding process. In 1994 eleven international sole-source company and consortium proposals were considered of which seven included external financing. The seven are listed in Table 1. Thomson, Dasa, Unisys, and Raytheon presented final proposals in

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[2] Scott Tollefson, "U.S. Policy Toward Latin America: An Historical Overview" (Monterey, CA: Naval Postgraduate School, September 1998, photocopied), 11.
[3] "Histórico do Projeto SIVAM- Cronologia," 1998, Available [Online]: <http://www.comsivam.org/sivam/projeto/hist4.htm> [10 August 1998].
[4] Ibid. Note the Ministry of Aeronautics is now the Aeronautics Command.

April 1994 and Raytheon appeared to be the favorite after the other six were eliminated due to noncompetitive cost projections.[5]

Company/Group	Country of Origin
Dasa/Alenia	Germany/Italy
Raytheon	USA
Thomson/Acatel	France
Unisys	USA
Fokker	Holland
IAI/Electronic	Israel
Sierra Technology	USA

Table 1. SIVAM Contract Contenders in 1994 From CCSIVAM, 1998.[6]

In June 1994, two days after Secretary of Commerce Ron Brown visited Brasília, President Itamar Franco awarded the SIVAM contract to Raytheon, eliminating Thomson CSF.[7] Thomson had tried underbidding its competitors by advocating Over the Horizon Radars (OTH) as a primary form of air traffic control. Despite OTH radar's many capabilities, Raytheon correctly pointed out they could not replace microwave ground based radars (GBRs) for air traffic control due to their lack of accuracy and reliability (see Chapter VI for more on OTH radars and DOD letter to Brazilian Congress in the Appendix).[8] According to President Franco, Raytheon was chosen because of superior financing terms and technical specifications.[9]

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[5] Ibid.
[6] "Histórico do Projeto SIVAM- Cronologia."
[7] Ibid.
[8] Anthony Merti, Program Manager, Raytheon ROTHR Program Office- Engineering, Telephone interview by author, Dahlgren VA, 24 May 1999, Raytheon Corporation; Office of the Department of Defense Coordinator for Drug Enforcement Policy and Support, *Letter from the Deputy Assistant Secretary for Drug Enforcement Policy and Support to Senator Gilberto Miranda* (30 October 1995), by Brian E. Sheridan. Washington D.C. Sheridan's letter states ROTHR could be degraded or negated because of proximity to the equator. This is probably no longer the case today, especially with system enhancements and dual ROTHR coverage. See Chapter VI.
[9] Jack Epstein, "Big Surveillance Project for the Amazon Jungle Teeters Over Scandals." *Christian Science Monitor*, 25 January 1996. Available [Online]: <http://www.csmonitor.com/cgi-bin> [3 August 1998].

In December 1994, the Brazilian Senate approved $1.35 billion in external financing for SIVAM. The timing of the vote was not good as it occurred after many legislators had already left for the holidays.[10] A senator allegedly received $7 million from an unknown party to speed approval.[11] Newly elected President Fernando Henrique Cardoso authorized the signing of the contract with Raytheon on 27 May 1995, after being briefed by CDN. Already, allegations of influence pedaling in the Senate and judicial opposition resulted in delays.

1. Allegations of Corruption

SIVAM bidding became mired in controversy and the contracting process was delayed for two years. Problems relating to the SIVAM contracting process reached international levels in 1995. Significant diplomatic interaction between U.S., Brazilian and French governments resulted.[12] The U.S. and French press divulged in February 1995 that the U.S. Central Intelligence Agency reported in 1994 that Thomson CSF was paying bribes to win the SIVAM contract.[13] French diplomats in turn accused the United States of bribing officials with $30 million.[14] The French government proceeded to charge the United States with industrial espionage and unfair dealings. The French claimed that CIA's information helped Raytheon win the contract.[15] Brazilian press received anonymous allegations that Raytheon had also paid bribes for the contract.[16] As a result, France expelled five staff members from the U.S. Embassy in Paris.[17] Relations eventually returned to normal.

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[10] Tollefson, 370.
[11] Ibid.
[12] Ibid.
[13] Ibid; Epstein; William Drozdiak, "French Resent U.S. Coups in New Espionage," *Washington Post*, 26 February 1995, A-1.
[14] Tollefson, 370.
[15] Drozdiak.
[16] The President of Raytheon Brazil, Richard Bartnik, told the author that Raytheon established good communications with the Brazilian press to help quell rumors of improprieties, and he was impressed by the integrity of Brazilian politicians. Bartnik was never approached by politicians for contributions. Bartnik, Richard, Former Raytheon President of Brazil, Interview by author 6 May 1999, Arlington VA, Raytheon Corporation; Epstien.
[17] Tollefson, 370; Drozdiak.

In March 1995, the Brazilian firm Automation and Control Systems Engineering (*Engenharia de Sistemas de Controle e Automação- ESCA*), part of the Raytheon consortium, was removed from the contract because it was found guilty of fraudulent reporting of its social security contributions.[18] ESCA was going to manage SIVAM and develop control software. Many opposed the removal of a Brazilian company from the contract. The incident embittered many in the Brazilian scientific community who were already opposed to the contract. Some believed that Brazil had indigenous capability to build such a system.[19]

The bidding controversy impacted domestic politics as well. In November 1995, an unconstitutional federal police wiretap was made public that revealed President Fernando Henrique Cardoso's aide, Júlio César Gomes dos Santos, had suggested, "a Brazilian representative of Raytheon pay off a senator heading a committee that was reviewing the project." In the transcript, the aide talked with Raytheon consultant Afonso Assumpção. Assumpção complained of the delays in the senate committee debating approval for the borrowing for SIVAM. He criticized the committee head, senator Gilberto Miranda, of not being friendly toward SIVAM. In the transcript, Santos replied "But didn't you already pay this guy?"[20] Senator Miranda denied taking any money. Santos resigned and withdrew his nomination to be the next Brazilian ambassador to Mexico.[21]

The bidding controversy also impacted the military. Soon after Santos' resignation, Aeronautics Minister Brigadier Mauro José Gandra also resigned after being accused of "influence-trafficking" in favor of Raytheon.[22] Gandra admitted to being a friend of Raytheon consultant Assumpção, but complicity was never determined.[23]

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[18] Tollefson, 370.
[19] A high-level, informed Raytheon official who asked to remain anonymous.
[20] "Brazil Traffic Control."
[21] Ibid; Edson Luiz, "Procuradoria Pede Quebra de Sigilo no Caso SIVAM," *O Estado de* São Paulo [São Paulo] 15 January 1998, Available [Online]: <http://www.estado. com.br/jornal/98/01/15/news024.html> [17 November, 1998]. Cardoso's aide later became the Brazilian representative for the Food and Agriculture Organization (FAO) at the UN, and continued to be investigated as late as 1998 for using this position to receive free trips.
[22] Ibid.
[23] Ibid.

The Brazilian Congress became interested in the SIVAM controversy. In 1995, Congress was pressured by environmental groups and governors in the Amazon region to review the SIVAM contract. According to *The Economist,* Raytheon's U.S. origins did not help garnish support from the Brazilian courts and congress, especially because of the nationalist opposition from the political Left. The fact that the tender process was not open to public scrutiny, and a Brazilian firm was removed, further embittered the situation.[24] A special senate commission was established to investigate the allegations of influence pedaling in the awarding of the contract.[25] Senator Antonio Carlos Magalhães of the Liberal Front Party (*Partido Frente Liberal-PFL),* and president of the foreign affairs committee, was selected to preside over the commission despite his opposition to Raytheon's selection.[26] This opposition ultimately gave credibility to the commission's findings that there was nothing to confirm impropriety by Raytheon or that Brazilian politicians had been bribed.

Raytheon also insisted there was no impropriety in the bidding process, and indicated they offered the best technology at a lower price. Raytheon's vice president for SIVAM, James Carter, went on record in 1995 that "We've done nothing wrong. The allegations of bribery are absolutely, positively not true."[27] Former President of Raytheon Brazil, Richard Bartnick, believed his open meetings with local press during that time helped quell false rumors and improve the image of Raytheon and the United States in Brazil.[28]

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[24] "Brazil Traffic Control."

[25] Michael Christie, "Raytheon Deal Sparks Tiff Between Brazil and U.S.," *Reuters*, 21 December 1995, Available [Lexis/Nexis]: WORLD/TXTCSA [10 October 1998].

[26] "Senate Opposition to Amazon Surveillance Project Appears to Be Waning," *Agencia Estado News Agency* [São Paulo] as provided by BBC Worldwide Monitoring, 12 January 1996, Available [Online]: <http://infoweb.newsbank.com> [27 July 1998].

[27] Carter reiterated this statement to the author. James Carter, Vice President Raytheon Electronic Systems, Telephone interview by author, 27 April 1999, Bedford Mass, Raytheon Corporation; Jack Epstein.

[28] Richard Bartnik, Former Raytheon SIVAM President in Brazil, Interview by author 6 May 1999, Arlington VA, Raytheon Corporation.

2. Bureaucratic Hurdles

Bureaucratic hurdles appeared as a result of the allegations. Brazil's National Accounting Office (*Tribunal de Contas da União- TCU*) originally suspected irregularities with the project because ESCA was selected without a formal tender.[29] In January 1996, the TCU decided it would support the SIVAM project and initiated an investigation to ensure that Ministry of Aeronautics[30] contracting procedures with Raytheon were legal.[31] TCU and the Congress approved funds in February 1997 and provided a final report in May 1997.[32] In April 1997, TCU concluded that alterations made to the contract were valid, despite opposition by Senator Antonio Carlos Valaderes of the Brazilian Socialist Party (*Partido Socialista Brasileira-* PSB*).*[33] The TCU was designated to audit the SIVAM project every six months as a bureaucratic safeguard.[34] This was done to appease the Brazilian Congress.

3. Judicial Hurdles

Judicial blocks also contributed to the two-year delay in the execution of the SIVAM contract. The first delay occurred in July 1995 when a federal judge barred Raytheon from taking part in the contract and suspended the agreement, in order to investigate allegations of influence pedaling.[35] In April 1997 two judges, one in Porto Alegre, in the state of Rio Grande do Sul, and another in Curitiba, Paraná concurrently suspended SIVAM contract execution because they thought the lack of a Brazilian firm

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[29] Ibid.
[30] Note that the Ministry of Aeronautics lost its ministerial status and is now called the Aeronautics Command with the creation of the Ministry of Defense in 1999.
[31] "National Accounting Office Will Investigate Amazon System Contract," *Agencia Estado News Agency* [São Paulo] provided by BBC Monitoring Service, 17 January 1996, Available [Online]: <http://infoweb.newsbank.com> [17 November, 1998].
[32] "Government to Resume Implementation of SIVAM," São Paulo FOLHA DE SÃO PAULO (10 February 1997), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 19 February 1997 (FBIS-TEN-97-002).
[33] Tania Monteiro, "Instalação do SIVAM so Depende de Bancos."
[34] Ibid.
[35] "Brazil, U.S. Officials Discuss Raytheon Contract." *Reuters*, 13 July 1995, Available [Lexis/Nexis]: WORLD/TXTCSA [10 October 1998].

created a nebulous situation capable of causing "irreparable damage" to the country.[36] President Fernando Henrique Cardoso was dissatisfied with the judicial blocks, stating that SIVAM had already been adequately scrutinized by the Senate and investigated by the TCU. None of these organizations had found any justification for delaying SIVAM.[37] Judicial delays ended in May 1997. Contract implementation finally began in July 1997.[38]

4. U.S. Government Influence In SIVAM Bidding

As early as the contracting phase, linkages between the United States and Brazil increased because of SIVAM. The United States government observed the difficulties faced by Raytheon with growing concern and decided to intervene. Commerce Secretary Brown led an interagency advocacy effort that ultimately influenced the bidding process in support of Raytheon.[39] Secretary Brown visited Brasília in June 1994, just prior to Raytheon's selection. President Clinton wrote a letter to Brazilian President Itamar Franco, supporting Raytheon's involvement in SIVAM (see the Appendix for a copy of the letter and other U.S. government advocacy documents).[40] The next significant political advocacy by U.S. government occurred in December 1995, when the U.S. ambassador in Brasília, Melvyn Levitsky, told the *Jornal do Brasil* that if the Brazilian government cancelled the agreement with Raytheon without a valid reason, bilateral relations between the two countries could be impacted.[41] His embassy had already encouraged Brazil's Congress to approve the contract earlier in May despite opposition

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[36] "Juiz do PR Anula Contrato do SIVAM," *O Estado de São Paulo* [São Paulo] 16 April 1997, Available [Online]: <http://www.estado. com.br/search/form-jornal.html> [16 November 1998]; Tania Monteiro, "União Recorrerá Contra Suspensão do Projeto." *O Estado de São Paulo* [São Paulo] 4 April 1997, Available [Online]: <http://www.estado.com.br/search/form-jornal.html> [16 November 1998].
[37] Ibid.
[38] Tania Monteiro, "Instalação do SIVAM so Depende de Bancos," *O Estado de São Paulo* [São Paulo] 10 May 1997, Available [Online]: <http://www.estado. com.br/search/form-jornal.html> [16 November 1998].
[39] Tollefson, 330; Paul W. Boyer, Assistant General Counsel, Telephone interview by author, 4 May 1999, Washington D.C., Export-Import Bank of the United States.
[40] The White House, Washington, *Letter from U.S. President to President of Brazil* (23 June 1994), by William J. Clinton. Washington D.C.
[41] Jorge, Zaverucha, "The Sivam Affair," UT Austin, 2 February 1995, Available [Online]: <http://lanic.utexas.edu> [15 September 1998].

from Amazon's regional governors.[42] Levitsky's statement was not well received in Brasília. President Fernando Henrique Cardoso replied by saying, "the ambassador has his opinion but he has spoken out of turn because Brazil hasn't taken any measures yet."[43] At the same time, the president of the Senate and former president of Brazil, José Sarney, stated "the ambassador's comments have been very inopportune and, to a certain extent, they interfere with an issue that is being discussed by Congress."[44] Senator Magalhães agreed with Sarney and implied that Brazil's sovereignty was being infringed with the following statement:

> He is defending a U.S. company but is doing it in a very inappropriate way. We must have very good relations with the United States but we should not be subject to the United States. He is clearly acting very badly as regards our country. We cannot accept this type of pressure from the U.S. ambassador.[45]

According to the *Rede Globo* television network, the United States was attempting to persuade Brazil to stay with Raytheon. It also claimed that Secretary Brown had warned of potential risk to future foreign investment in Brazil and possible intercession by President William Clinton.[46]

In speaking with Commerce Department, State Department, Department of Defense, and U.S. Export Import Bank (EXIMBANK) officials, the author found that government officials involved in supporting Raytheon were proud of the success of the inter-agency coordinated advocacy effort led by Secretary Brown. Brown later told U.S. Congress the SIVAM deal was "...proof of the indispensable role Commerce plays in assisting American companies."[47] An interesting twist: according to the Center for Public Integrity, "Raytheon had been generous to the Democracts... In January of 1995, after winning the SIVAM deal, Raytheon kicked another $15,000 to the DNC

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[42] Tollefson, 331.
[43] Christie.
[44] "Politicians React to U.S. Ambassador's Remarks on Impact of Canceling Contract." *Globo TV* [Rio de Janeiro] provided by BBC Monitoring Service, 20 December 1995. Available [Lexis/Nexis]: WORLD/TXTCSA [10 October 1998].
[45] Ibid.
[46] Ibid.
[47] Charles Lewis, *The Buying of the President*. New York: Avon Books and Center for Public Integrity, 1996, 67.

[Democratic National Convention], according to FEC [Federal Electoral Commission] records."[48] U.S. involvement with SIVAM evidenced the beginning of increased state and non-state linkages in the complex interdependence of both countries.

C. SIVAM ARCHITECTURE AND CAPABILITIES

After the controversy surrounding the SIVAM bidding process, the $1.25 billion contract with Raytheon to build SIVAM began to be implemented in July 1997. The financing details for SIVAM with EXIMBANK were also ironed out in 1997.[49] According to the Brazilian Commission for Coordination of SIVAM *(Comissão para Cordenação do SIVAM-* CCSIVAM), the purpose of SIVAM is to provide a surveillance architecture capable of integrating information and providing useful products to many users.[50] It combines information from various sources such as satellite, aircraft, meteorological sensors, radar stations, and communications exploitation (or Signals Intelligence-SIGINT) equipment. SIVAM is being built with an open architecture, allowing for addition of other types of sensors in the future.[51] The fused data will be used for environmental monitoring, land management, surveillance and air traffic control (ATC). The ultimate goal, according to CCSIVAM, is to both protect the Amazon and provide sustainable development.[52] Figure 4 depicts the location of the key SIVAM installations that are being constructed or are planned. Many major facilities will be co-located with military installations for greater physical security. The General Coordination Center (*Centro de Coordenação Geral- CCG*) will process and integrate all SIVAM data in Brasília (see Figure 5 below). Three Regional Vigilance Centers (*Centros Regionais de Vigilância*-CRV) located in Belem, Manaus and PortoVelho will provide regional control of SIVAM operations.[53] There is one Aerial Surveillance Center

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[48] Ibid., 68.
[49] "Brazil Finally Secures Eximbank Surveillance Project Facility As Banks Provide New Lending," *International Trade Finance* 286 (London) 9 May 1997, 5.
[50] Interview with Albuquerque Neto.
[51] Tim Carey, Assistant Manager SIVAM- Raytheon Electronic System, Telephone interview by author, 13 September 1999, Bedford Massachusetts, Raytheon Corporation.
[52] Ibid.
[53] Ibid.

(*Centro de Vigilância Aérea-* CVA) and one Logistics Center (*Centro de Apoio Logístico-* CAL) in Manaus. The CCG and CVAs will have similar structures based on major surveillance functions. Both will have the following components: [54]

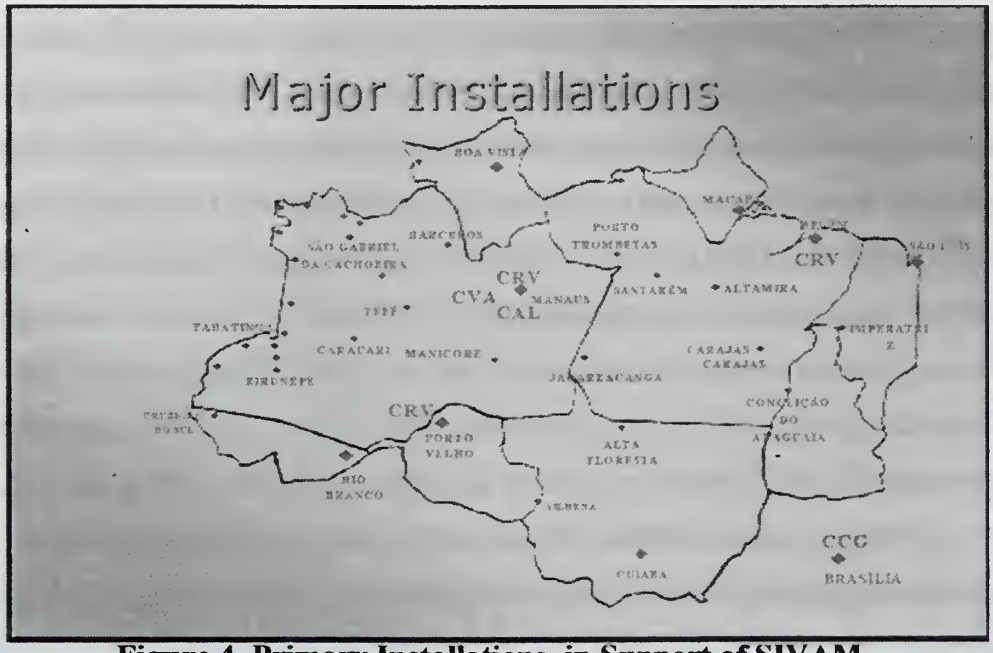

Figure 4. Primary Installations in Support of SIVAM
From CCSIVAM Presentation, 1998.[55]

1) Environmental Surveillance Sub-center;
2) Operations Planning and Control Sub-center;
3) Meteorology Sub-center;
4) Air-Land Surveillance Sub-center; and
5) Communications Surveillance Sub-center.

These sub-centers will process information from various sensors relating to their main functions.

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[54] Ibid.
[55] Ibid.

1. Aircraft Supporting SIVAM

SIVAM will be supported by a variety of aircraft with multiple functions. Variations of the ERJ-145 business jet, built by Brazil's Embraer, are being configured by Raytheon's E-Systems in Garland, Texas, for collections and aerial early warning (AEW). Eight ERJ-145 jets will be delivered starting in 2000 in two variants.[56] Initially, Embraer "Brasília" turboprops were going to fill the role, but the jet was selected for its excellent endurance at high altitude and speed of .7 mach. Embraer is also building a different type of aircraft that will be used for air patrol and intercept. It is called the ALX (EMB-314) Super-Tucano and it is being built in São José dos Campos, São Paulo.

Three ERJ-145RS (remote sensing) jets will be used for surface surveillance. The jets will be headquartered in Anápolis airbase in the state of Goias and the Super-Tucanos in a new airbase in Campo Grande, Mato Grosso do Sul.[57] They have a sizeable remote sensing package that will include a Synthetic Aperture Radar (SAR) camera, a Moving Target Indicator (MTI) sensor, an optical and infrared forward looking infrared (FLIR) television sensor, a Multi-Spectral System (MSS), and Communications/Non-Communications Exploitation Sensor (C/NCES). The SAR provides radar imaging with a resolution one hundred times better than Canada's RADARSAT. The SAR will be capable of imaging through the jungle evaporation fog (*Arú)* that commonly obstructs visibility in the Amazon forest.[58]

The MSS will provide multiple band spectrum imagery used for geological evaluation. The FLIR sensor will allow detection of warm objects such as vehicles, aircraft and personnel. The C/NCES suite will provide a signal exploitation capability and direction finding (DF) which are commonly used in modern militaries.[59] The C/NCES is capable of intercepting SIGINT at 30 MHz to 18 GHz.[60] Overall, the ERJ-145RS is one of the world's most capable surface surveillance assets. The only possible

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[56] Ibid.
[57] Paul Mann. "Brazil Shelters Strategic Amazon," *Aviation Week and Space Technology* 150, no. 23 (7 June 1999): 26; "New Anti-drugs Airbase for Brazil," *Jane's Defense Weekly* 32, no 1 (7 July 1999): 9.
[58] Interview with Albuquerque Neto.
[59] Ibid.
[60] Ibid.

limitation of the platform is that the sensors require line of site detection, and will be limited by thick jungle canopy. This will make detection of drug labs more difficult.

Five ERJ-145SA (aerial surveillance) airborne early warning (AEW) jets will be built with Ericson's "Erieye" air surveillance radar mounted on the upper fuselage. The "Erieye" will complement ground-based air surveillance radars by detecting low flying aircraft (typically below 10,000 feet).[61] According to *Jane's*, the range of Erieye is 162 nautical miles.[62] The surveillance jets also contain the C/NCES suite.

Embraer will supply ninety-nine ALX attack/trainer aircraft to FAB.[63] The majority will operate in support of SIVAM. The ALX Super Tucano aircraft will replace F-5s and Mirage 3s in FAB's light attack mission requirement and provide an air-air intercept capability in support of SIVAM.[64] For example, the aircraft will intercept smuggler aircraft and "if necessary destroy illegal mining and lumber camps in the Amazon."[65] Each plane carries two wing-mounted 12.7 mm guns, 20 mm cannon pods, and can deliver a variety of ordnance.[66] The ALX has an endurance of 300 knots for six and half hours. The ALX will also be fitted with night vision goggle (NVG) capability. Embraer publicly rolled out the ALX and the EMB-145SA on 22 May 1999.[67]

Airlift is an important component of SIVAM, given the geography and dispersion of its sites. In November 1998, Brazil made an amendment to the SIVAM contract to upgrade seven C-130E Hercules heavy transport aircraft and purchase five Cessna

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[61] Ibid.

[62] "Erieye Airborne Early Warning (AEW) Radar," *Jane's Radar and Electronic Warfare Systems 1998-99*, London: Jane's Information Group, 1998 and "Embraer- Empresa Brasileira de Aeronáutica SA: Embraer ERJ-145," *Jane's All the World's Aircraft 1998-99*, London: Jane's Information Group, 1998.

[63] Many will be used to intercept drug smuggling aircraft located by SIVAM's aerial surveillance. In the last few years, the Peruvian air force has brought down 65-70 drug-smuggling aircraft with the EMB-312, which is ALX's predecessor. See The *Military Balance 1998/9*. The International Institute for Strategic Studies, London: Oxford University Press, October 1998, 207; Jackson Flores Jr., "Brazil's New Teeth," *Flight International*, 26 May-1 June 1999, 48; Damian Kemp, "Brazil Rolls Out Embraer Aircraft for SIVAM Project," *Jane's Defense Weekly* 31, no. 23 (9 June 1999): 16.

[64] James T. McKenna, "Raytheon to Start Work On Amazon Project." *Aviation Week and Space Technology* 145, no. 13 (23 September 1996): 50-51.

[65] Ibid.

[66] "New Anti-drugs Airbase for Brazil," *Jane's Defense Weekly* 32, no 1 (7 July 1999): 9.

[67] "Embraer- Empresa Brasileira de Aeronáutica SA: Embraer EMB-314 Super Tucano," *Jane's All the World's Aircraft 1998-89*, London: Jane's Information Group, 1998; McKenna; Damian Kemp, "Brazil Rolls Out Embraer Aircraft for SIVAM Project," *Jane's Defense Weekly* 31, no. 23 (9 June 1999): 16; Virginia Silveira, "Embraer to Deliver 100 ALX Planes to Air Force," São Paulo GAZETA MERCANTIL

Caravan single turboprop light transport aircraft.[68] According to a knowledgeable EXIMBANK official, other amendments for purchases such as heavy lift helicopters may be made.

2. Ground Equipment

SIVAM complements aerial surveillance with ground-based radars (GBR) and ground surveillance technology. The GBRs will consist of seven fixed, seven stand-alone, and six mobile ATC radar stations.[69] There will also be ten weather radar stations. The ATC radars will provide one hundred percent coverage of the region in order to track aircraft above 10,000 feet.[70]

The fixed ATC radars will be the 25-kilowatt Raytheon ASR-10SS, with either a 120 or 200 nautical mile range, depending on the version.[71] The mobile radars will be modified Lockheed-Martin AN/FPS-117 3-D radars with a range 150 nautical miles.[72] They will be mounted on tractor-trailers.[73]

Raytheon also plans to install two hundred floating monitoring stations throughout the Amazon region's rivers and tributaries. They will detect changes in water turbidity such as increases in mercury and rainwater content.

Several fixed communication nodes will be installed operating in the Very High Frequency (VHF) and Ultra High Frequency (UHF) frequency ranges. The communications stations will use satellite dishes to link the CCG to the three CRVs using

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(23 April 1998), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 25 April 1998 (FBIS-LAT-98-115).

[68] Brian Walters, "Air Force News, Brazil- Hercules Upgrade For SIVAM," *Jane's Defense Upgrades* 2, no. 22 (13 November 1998): 4. During this time, the SIVAM contract and the C-130 amendments were briefly held up due to U.S. liability concerns over the new Brazilian shoot-down law.

[69] Tim Carey, Deputy Manager SIVAM- Raytheon Electronic Systems, Telephone interview by author, 13 September 1999, Bedford Massachusetts, Raytheon Corporation.

[70] CCSIVAM.

[71] "Airspace Management- Radar and Satellite Surveillance and Automation- United States of America," *Janes Air Traffic Control 1998-99,* London: Jane's Information Group, 1988. The author could not determine which version will be installed.

[72] "Land-Based Air Defense Radars, United States of America: AN/FPS-117 Air Defense Radar," *Jane's Radar and Electronic Warfare Systems 1998-99,* London: Jane's Information Group, 1998. The author could not determine the type of fixed radars that will be used in SIVAM.

[73] John Knowles, "Brazil Taps Lockheed Martin for SIVAM Radars," *Journal of Electronic Defense* 20, no. 9 (September 1997): 32-33.

four BRASILSAT telecommunication satellites. This will provide telephone connectivity to over eight-hundred remote regions in the Amazon.[74] These stations will have communications exploitation/ signals intelligence (SIGINT) and direction finding (DF) capabilities commonly used for intelligence gathering.[75] According to *Journal of Electronic Defense,* the DF package will cover HF/VHF/UHF ranges with the Watkins-Johnson 8986 system.[76]

Numerous lightning detectors will be installed for analysis of electrical storm activity. These studies will help route future high-tension wires built in the region. Additionally, several ground based meteorological radar domes and balloon stations will be built. The Brazilian firm Tectelcom (*Tecnica em Telecomunicação*) is building SIVAM's ten Doppler meteorological radars. The radars have a range of 400 kilometers and an altitude of twenty kilometers.[77] The weather data will be used in conjunction with air traffic control, and for studies of the Amazon.

3. Space Sensors

A variety of sensor satellite capabilities will be utilized through large satellite receive antennas. Raytheon is upgrading Brazil's National Institute of Space Research's (INPE) receive and processing capabilities.[78] Brazil has contracts with several countries for commercial satellite imagery. This imagery will be integrated into SIVAM. The Canadian RADARSAT and the Japanese JERS-1 will provide SAR coverage capable of imaging through clouds and smoke. Both the U.S. LANDSAT-7 and the French SPOT-4 satellites will provide Electro-optical (EO) imagery.[79] LANDSAT will have a revisit time of every two weeks.

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[74] Allen, Scott. "'Eye' on the Rain Forest Relies on Space, Ground, Air Sensors." *Boston Globe (MA),* 31 March 1997, C1.
[75] Interview with Albuquerque Neto.
[76] Zachary Lum, "Searching for Shadows: Surveillance in Latin America; Military Electronics Market," *Journal of Electronic Defense* 19, no. 11 (1996): 35.
[77] "Brazil: SIVAM Meteorological Radars to be Manufactured Locally," *Agencia Estado News Agency* [São Paulo] as provided by BBC Worldwide Monitoring, 16 May 1997. Available [Online]: <http://infoweb.newsbank.com> [27 July 1998].
[78] Raytheon SIVAM Fact Paper (4 May 1998).
[79] Interview with Albuquerque Neto.

After several delays, China and Brazil cooperatively launched the China-Brazil Earth Resources Satellite (CBERS-1) in October 1999 in central China.[80] CBERS-1 will support SIVAM with a coherent change detection (CCD) camera with a resolution of twenty meters, an infrared multispectral scanner (IR-MSS) with a resolution of eighty meters, and a Wide Field Imager camera (WFI) with a resolution of 260 meters. The WFI will be used to locate areas to be zoomed by the CCD. The satellite, which is thirty percent financially and technically Brazilian, will be useful in supporting SIVAM in mapping, monitoring earth resources, and studying cloud, smoke and aerosols in the Amazon.[81]

4. Whole as Greater than Sum of Parts

SIVAM's architecture and integration of diverse data from numerous ground and aerial sensors gives it an exceptional capability. SIVAM data will be processed by powerful computer systems linked between the CCG and three CRVs. The computers will select likely spots to be investigated. According to Raytheon's SIVAM coordinator Carlos Gonzaga, "At the punch of a few computer keys, analysts in an office building will be able to see everything from river pollution levels to suspicious planes, to the location of Brazil nut trees..." in a specific region.[82] The high power computers at the CCG in Brasília will integrate data from the listening posts as well as conventional data such a police reports to form segmented limited access databases.[83]

For example, in March 1997, Raytheon conducted a successful computer simulation exercise in the United States demonstrating how SIVAM will be able to locate a hypothetical illegal gold mine in the state of Rondonia.[84] Images from LANDSAT revealed a new airstrip in the jungle. SIVAM was challenged with searching an area twenty-five kilometers around the airstrip. An EMB-145RS jet with a multi-spectral

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[80] NASA's SPACEWARN Internet homepage provides status of satellite launches worldwide. See <http://nssdc.gsfc.nasa.gov/spacewarn/spacewarn.html>; Interview with Dr. David Fleischer; Krug.
[81] Ibid.
[82] Allen.
[83] Interview with Albuquerque Neto.
[84] Allen.

scanner (MSS) was simulated as being sent to the area. The MSS was used because it is capable of detecting objects as small as a tree by analyzing shapes at different frequencies. The aircraft also employed a SAR sensor using microwave patterns to detect objects invisible below the foliage. SIVAM narrowed the search by checking water monitors in the area for signs of mining and turbidity. SIVAM also processed simulated intercepted communications and combined this with information provided by a convicted illegal miner. The computer calculated the most likely location for the mine using fuzzy logic designed to analyze uncertain situations. All that would remain in real life would be to dispatch Federal Police and IBAMA inspectors to the area to shut down the operation.[85]

D. SIVAM ORGANIZATION

SIVAM serves numerous actors due to its multiple capabilities. Its organization reflects this complex requirement. Once operational in 2002, it will provide "surveillance products" to multiple government and non-government organizations (NGOs) as well as the scientific community. Government customers will include military and civilian agencies at the federal, state and local levels. Table 2 lists the principal government agencies that SIVAM will support. The list is not all-inclusive, and will probably change somewhat over time. For example, the state-owned oil conglomerate Petrobrás recently contracted to access SIVAM's database in exchange for technical training of radars for SIVAM personnel.[86] Petrobrás will use this data to support it facilities in the region.

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[85] Ibid.

[86] "Petrobrás to Assist SIVAM With Training, Research," São Paulo FOLHA DE SÃO PAULO (6 July 1999), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 7 July 1999 (FTS19990707000435).

Organization
Ministry of Science and Technology
Ministry of Justice (e.g. Federal Police- *Polícia Federal*)
Ministry of the Environment and the Amazon (IBAMA)
Ministry of Transportation
Ministry of Health
Aeronautics (Brazilian Air Force- FAB)
Navy
Army
Ministry of Social Security
Secretary of Planning, Budget and Coordination
Ministry of Regional Integration
Ministry of Agriculture. Supply and Land Reform (INCRA)
Ministry of Education
Ministry of Communications
Ministry of Mines and Energy
Ministry of Finance
Secretary of National Anti-Drugs *(SENAD)*
Ministry of Foreign Relations (Itamaraty)
National Indigenous Foundation (FUNAI)

Table 2. Principal GOB SIVAM Customers From Raytheon SIVAM Pamphlet (May 1995).

SIVAM is also capable of satisfying multiple functions. Table 3 categorizes the major functions of SIVAM and describes these functions in detail, as well as portions of SIVAM's architecture that will support major Brazilian government agencies.[87]

SAE's[88] main function was formulating national security policies and strategic issues. As a special ministry, it had direct access to the president. It also managed strategic (missile, space, armaments) and intelligence programs.[89] Later, MEPE headed SIPAM (System of Protection of the Amazon) of which SIVAM is its main tool. MEPE was to retain overall responsibility for SIVAM once it is completed (see Figure 5 on page 45).[90]

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[87] Interview with Albuquerque Neto.

[88] Cabinet reshuffles in July 1999 resulted in MEPE's demise, and SIVAM responsibility will probably be transferred to the Ministry of Defense and/or Science and Technology, which is headed by minister Ronaldo Sardenberg.

[89] Tollefson, 362.

[90] "Brazil Acting to Control Airspace to Curb Smuggling in Amazon Region," *Folha de São Paulo*, 22 July 1996. Available [Lexis/Nexis]: WORLD/TXTCSD [4 August 1998].

Aeronautics is heading the implementation of SIVAM due to its previous experience with large foreign contracts like Thomson's CINDACTA Integrated Air

Category	Functions	Required Capabilities	Benefits	Beneficiaries
Law Enforcement	Monitoring drug traffic, mineral/hard wood smuggling, demarcation lines/invasions, monitor Indian reservations, national borders, illegal burns, river navigation	Satellite imagery, MSS, SAR, Primary ground- airborne radars, airborne IR surveillance, airborne sensors, DF, SIGINT, data processing, dedicated software- databases	Reduce drug usage and crime, increase tax collection, protect forest, protect national sovereignty, protect Indian populations, control agriculture illegal use, reduce navigation hazard and illegal traffic	Army, FAB, Navy, Federal police, State police, Ministries of Health- Agriculture- Finance , IBAMA, FUNAI, EMBRAPA, Local industry
Environment	Monitoring deforestation, forest fires, flood, river pollution, air pollution.	Satellite imagery, weather satellite-stations-radars, aerial surveillance, airborne sensors, Environmental monitors, investigation reports, data processing, databases	Ecological preservation, control of land use, selection of areas for development, combating illegal mining.	IBAMA, local communities and governments, Indians, FUNAI, INPA, EMBRAPA, Federal police, CPTEC
Civil and Military Affairs	Support to zoning and land use, flood prediction, climatologic and weather forecast, telecommunications, mapping and cartography, health	Satellite imagery, airborne sensors, MSS, SAR, weather satellite images, ground weather stations- altitude weather stations, environmental monitors, VSAT, HF network, Line of site, radio links, Environmental monitors, network databases, software	Land use delimitation, dam site and power grid planning, road route planning and construction, disaster alerts, climate modeling, agriculture development, flight safety, radio/TV and regional integration, urban development, disease control	IBAMA, IBGE, Ministry of Agriculture- Agrarian Reform- Mines and Energy- Transportation, Aeronautics- Health, Federal Police, Civil Defense, CPTEC, INPA, EMBRAPA, Universities, International community, Civil construction companies, Community hospitals, Telecommunications systems, Local communities
Air Traffic Control	Navigation support, control of cooperative aircraft with or without transponder, display of non-cooperating aircraft.	NDB/VOR-DME, Global positioning system, primary and secondary radars, 3D radars.	Reduce flight time and cost, increase safety and control, reduce smuggling, drug traffic, crime	ATC authorities and users, FAB, Federal Police.

Table 3. Functions of SIVAM (refer to acronym page) After Raytheon Corporation, 1996.[91]

Defense System (*Centro Integrado de Defesa Aérea e Controle de Tráfego Aéreo*). The Aeronautics is also responsible for civil air traffic control (ATC) throughout Brazil with its organizations known as Infraero and Department of Civil Aviation (*Departamento de Aviação Civil*- DAC). Upon SIVAM completion, Aeronautics will cede its role as SIVAM contract manger and will operate only the ATC portion of SIVAM with the Aerial Surveillance Center (CVA- *Centro de Vigilância Aérea*) in Manaus.

[91] See Raytheon's SIVAM Internet homepage at <http://www.raytheon.com/sivam/sivameng.html>.

Traditionally, the military has exerted significant influence over SAE. President Fernando Henrique Cardoso intended to decrease military influence over SAE as part of Brazil's democratization process. In this vein, he nominated a well-respected civilian and former Brazilian ambassador to Russia and the United Nations, Ronaldo Sardenbeg, to head SAE in 1995.[92] He was the first civilian with no military experience to head SAE.[93] SAE also oversaw the Brazilian intelligence agency (SSI). The SSI has strong interest in the region, particularly with the MST problem discussed in Chapter II. In fact, the SSI maintains extra representation at Marabá, in Pará due to "tension in the field."[94] The Defense Ministry may have greater influence over SSI and intelligence once it is fully reorganized.[95] SIVAM will probably have links into Brazil's intelligence structure in order to better support combatting regional problems.

The Aeronautics will manage the aerial surveillance center in Manaus because of its national air traffic control function similar to the U.S. Federal Aviation Administration (FAA). However, Aeronautics (and FAB's) involvement implies a strong military interest in the project. FAB manages CCSIVAM. FAB general (*brigadeiro*) José Orlando Bellon is the president of CCSIVAM.[96] CCSIVAM is developing SIVAM hardware and software in conjunction with Raytheon, and it is primarily made up of air force personnel and Foundation for Application of Critical Technologies (*Fundacão Aplicações de Tecnologias Críticas*- ATECH) engineers. ATECH is a non-profit engineering organization formed to serve Aeronautics. ATECH plays a significant role in SIVAM's technical development due to the experience and education of it technicians.

In summary, this chapter described the significant linkages established between U.S. and Brazil foreign relations as a result of the difficult SIVAM bidding and contracting process. The chapter also described SIVAM's architecture and organization. SIVAM has many uses such as law enforcement, environmental monitoring and air

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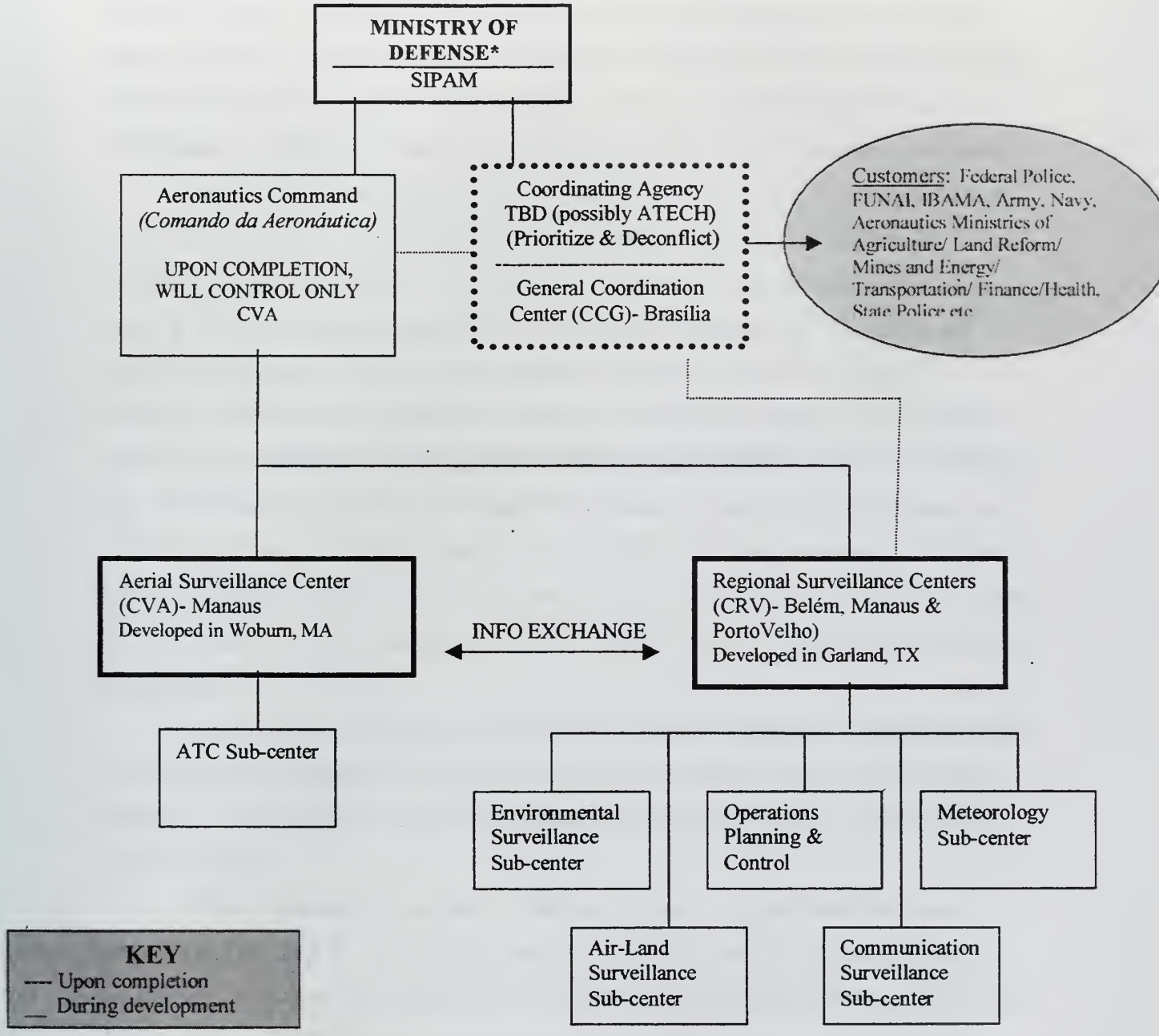
[92] Tollefson, 362.
[93] Ibid.
[94] Ibid.
[95] "Career Diplomat Sardenberg Reportedly to Head New Defense Ministry," *O Globo* [Rio de Janeiro] as provided by BBC Worldwide Monitoring, 17 January 1998, Available [Online]: http://infoweb.newsbank.com> [20 October 1998].
[96] Sônia Cristina Silva, "Jurista Quer Leis Para Defender Recursos Naturais," *O Estado de São Paulo* [São Paulo] 13 May 1999, Available [Online]: <http://www. estado.com.br/search/form-jornal.html> [27 July 1999].

traffic control. Raytheon's involvement allows the United States to provide critical technical support to SIVAM's complex architecture. It might also facilitate future cooperation between the two countries.



* Although some SIPAM functions may be retained by Ministry of Science and Technology.

Figure 5. SIVAM Organizational Chart After CCSIVAM (September 1999).[97]

[97] Interview with Albuquerque Neto.

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IV. SIVAM LIMITATIONS

This chapter will analyze organizational and architectural limitations with SIVAM. Chapter VI will describe how these deficiencies can be mitigated with U.S.-Brazil cooperation. SIVAM's current architecture has limited ability to detect low flying aircraft carrying drugs across borders. Further, Brazilian agencies using SIVAM's surveillance, especially for counter-drug operations, need to be effectively coordinated.

First, a SIVAM coordinating body to handle prioritization and deconfliction of surveillance tasking, and production requirements from many Brazilian agencies has not yet been organized (see figure 2, on page 18). The lack of a coordinating body could result in SIVAM being dominated by one of its powerful customers. SIPAM is not manned and equipped to handle the coordination function. This could result in interagency rivalry and a perception of failure by the Brazilian people. SIVAM could also become "militarized" as the ministry of defense may attempt to fill the coordination gap. The military (through the Aeronautics Command) already has great influence over SIVAM by virtue of it being responsible for developing and implementing it. SIVAM's failure to adequately support law enforcement efforts and Brazilian OOTW in the region could adversely impact relations with the United States due to Raytheon's involvement in the project.

The lack of an oversight mechanism for SIVAM's surveillance capabilities could reinforce an already negative perception of intelligence organizations by the Brazilian populace. Any organization involved in counter-drug support should be safeguarded from corruption.

SIVAM's limited low altitude surveillance capability is provided the most attention in this chapter. SIVAM has limited low-altitude detection capability due to insufficient space-time coverage (ESTC)[1] by Ground Based Radars (GBR) and Airborne Early Warning (AEW) aircraft. A secondary aim of this chapter is to mathematically demonstrate how barring an adjunct such as over the horizon radar coverage, SIVAM would require either 347 GBRs or 62 AEW aircraft (or a combination) to satisfy

SIVAM's low altitude space-time coverage of Brazil's northwestern border.[2] SIVAM's failure to properly support control Brazil's sovereign airspace would be a major shortcoming of the architecture.

A. ORGANIZATIONAL LIMITATIONS

Figure 5 on page 45 depicts the CCG in Brasília that will conduct day-to-day technical coordination. Even with the CCG in place, there is still no overarching operational coordination body for SIVAM. However, there are signs that this issue is being addressed. In September 1999, President Cardoso met with the Armed Forces High Command (including Minister of Defense Élcio Álvares, General Alberto Cardoso and service commanders), as well as Foreign Minister Luiz Felipe Lampreia and thirty other four star generals to define coordination of SIVAM.[3] The results of this meeting have not yet been announced.

A SIVAM oversight process has also not been identified.[4] Lack of an effective body subject to oversight could result in:

1) Abuse of SIVAM collection capabilities such that citizen liberties and freedoms would be violated, and
2) Corruption possibilities, especially with SIVAM officials being approached by criminals for sensitive counter-drug information.

Brazil's drug czar in SENAD emphasized the need for an effective oversight mechanism in any organization involved in combating drug trafficking. He stated that: "The

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[1] Effective space-time coverage (ESTC) is used because it provides measurement of area covered while accounting for the time dimension as well.
[2] See notes 15-17 and 23-26 for supporting calculations.
[3] Tania Monteiro and Edson Luiz, "Armed Forces High Command Meets to Coordinate SIVAM", São Paulo O ESTADO DE SÃO PAULO (4 September 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 8 September 1999 (FTS19990908000382).
[4] As of late September 1999, there are preliminary indications an organization known as COMSIPAM (*Conselho do Sistema de Proteção do Amazonas)* will meet periodically in the Civil Household, in the president's cabinet for SIVAM oversight purposes. Interview with Albuquerque Neto.

government needs to offer the society a mechanism so that it may protect itself even from those who represent it."[5]

The Brazilian military has generally been free of corruption. However, even this institution is vulnerable. For example, a Federal Police official testified to the CPI on narco-trafficking in May 1999, that a drug trafficking gang has been involved in several incidents involving FAB aircraft to smuggle drugs.[6] One of the issues the CPI was investigating was a drug smuggling incident that occurred in 19 April 1999, in which a load of 36 kilograms of cocaine was seized from a FAB C-130 Hercules transport in Recife, Pernambuco.[7] Two FAB lieutenant colonels, one on active duty and the other a reservist, were prosecuted for shipping the trunks containing the drugs on the plane.[8] A few days later, Aeronautics Chief Walter Werner Brauer testified before the CPI that "the fact that members of the armed forces are involved in drug trafficking is not surprising."[9] The CPI asserted that all branches of Brazil's military are in some way involved in international drugs smuggling.[10] The CPI concluded that: 1) the FAB incident indicates that prominent Brazilian drug trafficking gangs are using military personnel and equipment; 2) that the gang was large;[11] and 3) there is a drug corridor to European

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[5] Ibid.

[6] "Jailton de Carvalho, "Tráfico Livre na Amazonia: Delegado Denúncia que PF Tem Apenas 15 Homens na Região," *Jornal do Brasil* [Rio de Janeiro] 12 May 1999, Available [Online]: <http://www.jb.com.br> [12 May 1999], "Drug Trafficking Gang in FAB Case 'One of Best.'" São Paulo JORNAL DA TARDE (14 May 1999). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 17 May 1999 (FTS19990517001565), Jailton de Carvalho, "More Members of Armed Forces Suspected on Drug Trafficking," Rio de Janeiro JORNAL DO BRASIL (6 May 1999), Translation by the Foreign Broadcast Information Service, FBIS *Daily Report—Latin America;* 6 May 1999 (FTS19990506001690), Hugo Marques, "2,3 Mil Aviões Levam 400 t de Cocaína no País," *O Estado de São Paulo* [São Paulo] 19 May 1999, Available [Online]: <<http://www.estado.com.br/search/form-jornal.html> [19 May 1999].

[7] The plane had taken off from Rio de Janeiro, when the Federal Police warned Aeronautics police of a tip that the aircraft was carrying drugs. The plane was destined for Spain. "Air Force Plane Found With 36 kg of Cocaine," Brasília CORREIO BRAZILIENSE (20 Apr 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 21 April 1999. (FTS19990421001374).

[8] Ibid.

[9] Aluizio Freire; "CPI to Question Aeronautics Head on FAB Cocaine Incident," Rio de Janeiro JORNAL DO BRASIL (21 April 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 23 April 1999 (FTS19990421001988).

[10] "More Members of Armed Forces Suspected on Drug Trafficking," Rio de Janeiro JORNAL DO BRASIL (6 May 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 6 May 1999 (FTS19990506001690).

[11] The article did not specify the numbers.

markets.[12] The CPI's conclusions highlight the vulnerability of even the military to corrupting power of drug money, and the need for organizational safeguards to protect SIVAM officials and others in this area.

B. ARCHITECTURAL LIMITATIONS

SIVAM's existing surveillance architecture will not adequately detect low altitude aircraft in the Amazon region. The small number of ground based microwave radars (GBR) can provide adequate coverage only for higher-flying aircraft. Likewise, Airborne Early Warning (AEW) aircraft are costly to operate and thus FAB can operate only a small number of them at a time. A possible solution described in Chapter VI, is an over the horizon (OTH) radar. Without OTH radar augmentation to GBRs and AEWs, they will not be able to reliably provide the type of low altitude data necessary for FAB Super-Tucano ALX aircraft to intercept illegal aircraft such as those carrying drugs.

As pointed out in Chapter III, twenty SIVAM GBRs will form the aerial surveillance and air traffic control ATC package. These GBRs will cover one hundred percent of the region's airspace, but only for aircraft flying above 10,000 feet.[13] Illegal aircraft flying below that altitude will have significantly less chance of being detected by GBRs unless an Airborne Early Warning (AEW) Aircraft is within detection range (see Figure 6). The probability of detection decreases as the target aircraft flies lower. Table 4 portrays how radar detection range in nautical miles increases as the target aircraft flies higher.

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[12] "Drug Trafficking Gang in FAB Case 'One of Best.'" São Paulo JORNAL DA TARDE (14 May 1999). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 17 May 1999 (FTS19990517001565), "Cocaine in FAB Plane: 'Horrifying Involvement'," Brasília CORREIO BRAZILIENSE (22 April 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 26 April 1999 (FTS19990426001156).

[13] Interview with Albuquerque Neto.

Target Aircraft Altitude (ft)	Radar Detection Range (nm)
0	0
500	28
1,000	39
5,000	87
10,000	123
15,000	150
25,000	194

Table 4. Impact of Target Altitude on Radar Range From Robert M. Williams.[14]

The table illustrates how GBRs have limited low altitude coverage. For example, for targets flying at 500 feet, the twenty GBRs together would cover less than 50,000 square nautical miles.[15] Less than one half of this GBR coverage at this attitude is in the Amazon region border area. A better measure of the effectiveness of GBR coverage of low altitude airspace is the calculation in terms of space and time. This is known as effective space-time coverage (ESTC) and its unit of measurement is square nautical miles x hours.[16] Thus, SIVAM's twenty GBRs can provide 176 million square nautical miles x hours of ESTC coverage of Brazil's border area for aircraft at 1,000 feet.[17]

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[14] Numbers are rounded to nearest digit. The table is derived from the standard radar equation that reflects probability of detection in a given altitude: $R= 1.23 \times \sqrt{H} + \sqrt{E}$, where R is radar range in nautical miles, H is height of target in feet and E is altitude/elevation of radar in feet. Note that maximum range of most radars is 270 nm. Robert M. Williams, Special Assistant to CINCSO Technology and Requirements, Interview by author, 7 May 1999, Washington D.C., U.S. Southern Command Washington Field Office.

[15] Recall the area of circle (or range circle of the GBRs at 1,000 feet) is πr^2. In referring to Table 4, we see that the range of radars for targets of that altitude is 39 nm. Calculations as follows:

Area of a circle is $A=\pi r^2$

Where A is area covered by a GBR, r is range of the GBR at 1,000 feet target altitude per Table 4.

$A=(3.14)(39)^2$

A= 2461.76 square nautical miles (for one GBR)

As there are 20 GBRs

20 × 2461.76= 49,235 sq. nm

[16] Interview with Robert M. Williams.

[17] Calculations as follows:

Assuming 95 detection probability and 85 percent availability of radar

$ESTC_{GBR}$= Total GBR coverage × days in a year × hours in a day ×.95 × .85

$ESTC_{GBR}$= 50,000 sq. nm × 365 days × 24 hours ×.95 ×.85

$ESTC_{GBR}$= 353,685,000 square nautical mile × hours

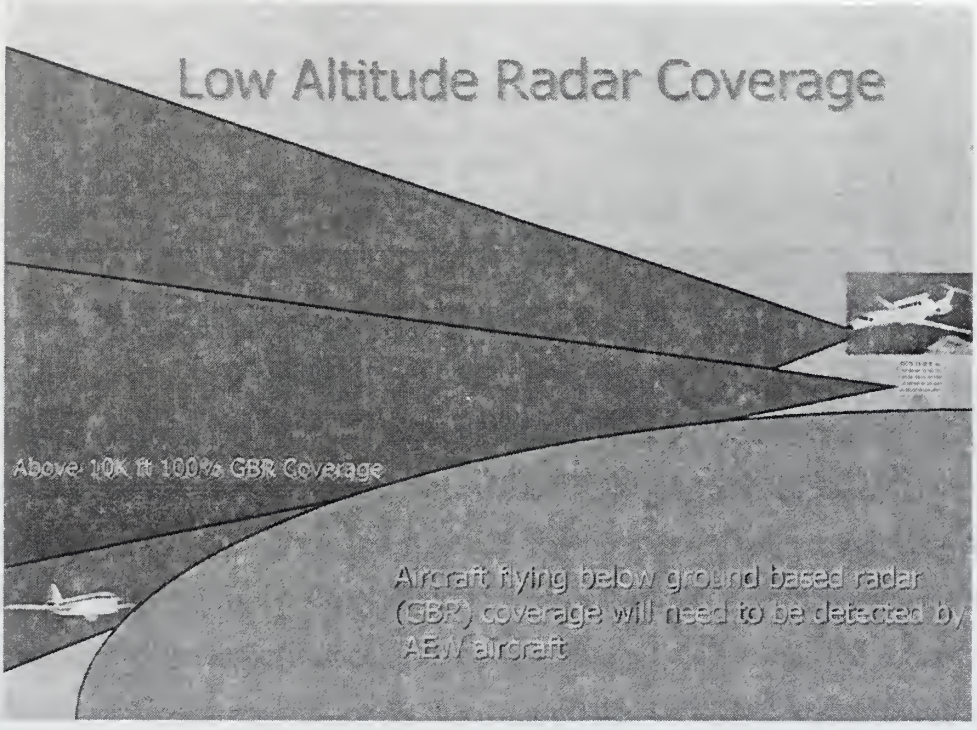

Figure 6. Ground Based Radar (GBR) Low Altitude Coverage After CCSIVAM Briefing (1998).[18]

How does GBR space-time coverage compare with the total size of the border? Assuming the reference area will be Brazil's borders with Colombia, Peru and the Bolivia, that border is approximately 2,160 nautical miles long. For calculation purposes, the width of the border will be 324 nautical miles as this is the diameter of the swath of the AEW radar (Erieye). The ESTC for the border to be covered continually (24 hours a day every day all year) is very large. It is 6.13 **billion** square nautical miles x hours.[19] Thus, GBRs would cover only 2.9 percent of ESTC requirement in this area to detect low

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As one half of total coverage is in the border area
ESTC border= 353,685,000 / 2
ESTC border= 176,842,500 square nautical mile × hours

[18] Interview with Albuquerque Neto.

[19] Calculations as follows:
ESTC= Hours in a day × days in a year × L × W= 8760 hrs/ yr
Where L is length of border in nautical miles
W is width of Erieye swath in nautical miles
ESTC= 24 hours× 365 days × 2160 nm × 324 nm= 6130,598,400 square nautical mile × hours

altitude aircraft (also see Table 5 in Chapter VI).[20] Accordingly, it would require almost 347 radars (without the help of AEW aircraft) to fully cover the border space-time requirement to detect low altitude aircraft.[21]

Brazilians are aware that wide area low altitude coverage was not originally included in the existing SIVAM system.[22] SIVAM planners were aware of GBR's low altitude limitations and thus planned for AEW coverage to fill the low altitude gap on a limited basis. However, SIVAM AEWs do not sufficiently satisfy low altitude coverage requirements. SIVAM has five ERJ-145SAs, each with an Erieye AEW radar that will enable detection of low altitude aircraft assuming they are in range. The Erieye radar has a range of 162 nautical miles for an aircraft sized target and as stated before, a swath width of 324 nautical miles.[23] If one cross-applies the formula used to calculate Table 4 to AEW aircraft, we find that the AEW aircraft improves detection for low flying targets. Assuming a target aircraft is flying only 100 feet, and the AEW aircraft is at 25,000 feet within 162 nautical miles, the Erieye can accurately detect this aircraft within its maximum range capabilities (in this case at 162 nautical miles).[24]

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[20] Calculations as follows:

ESTC requirement= $ESTC_{GBR}$ / ESTC border
ESTC requirement= 176,842,500 sq. nm hours/ 6130,598,400 sq. nm hours
ESTC requirement= .0288

[21] Calculations as follows:

GBR number required= ESTC border/ ESTC for each GBR
GBR number required= 6130,598,400 sq. nm hours/ 17,684,250 sq. nm hours
GBR number required= 346.70

[22] Tim Carey, Deptuy Manager SIVAM- Raytheon Electronic Systems, Telephone interview by author, 13 September 1999, Bedford Massachusetts, Raytheon Corporation. Low altitude capability was probably not an original requirement for SIVAM in the early 1990s because rampant drug trafficking through Brazil's sovereign airspace is a relatively recent phenomenon.

[23] "Erieye Airborne Early Warning (AEW) Radar," *Jane's Radar and Electronic Warfare Systems 1998-99*, London: Jane's Information Group, 1998 and "Embraer- Empresa Brasileira de Aeronáutica SA: Embraer ERJ-145," *Jane's All the World's Aircraft 1998-99*, London: Jane's Information Group, 1998.

Calculation as follows:
Swath Width= 2 × Erieye Range (illuminating on both sides of aircraft)
Swath Width= 2 × 162 nm
Swath Width= 324 nm

[24] Calculations as follows:

$$R = 1.23 \times \sqrt{100 + 25{,}000}$$

Where R is range in nautical miles and R max= 162 (Note: maximum range of Erieye is 162 nm)
R= 195 nm, but since R max= 162
R= 162 nm

Despite the detection advantages of using AEW aircraft to locate low flying targets, it has two significant operational limitations. The first is that the high cost of AEWs limits the number of AEW aircraft that can provide coverage. The second is that ESTC of AEW assets are limited. For example, assuming the operations and maintenance (O&M) cost of an ERJ-145 is nominally $3,000 per flight hour,[25] the annual expenditure of only five AEWs is estimated at $18 million.[26]

AEW has limited space-time coverage capability. In determining the ESTC of SIVAM's AEW along the border, we must look at a concept known as barrier length.[27] Barrier length is the amount of border that can be covered by an AEW with a ninety percent probability of detection. It depends on several factors. The speed of the target, speed of the AEW, and length of the barrier are all considered in determining the barrier length for a given AEW. The barrier length of the ERJ-145SA is about 700 nautical miles.[28] In addition to barrier length, total AEW time on station (TOS) and mission availability rate (MAV) also impact ESTC. Assuming an 85 percent mission availability rate, the ESTC for the five AEWs conducting a barrier type operation along the border is 520 million square nautical miles × hours.[29]

This may seem like sizeable space-time coverage, but it is not. When divided by the space-time requirements of the border, AEWs satisfy only 8.5 percent of the

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[25] O&M costs include direct flight costs and other costs such as manning and extra equipment like sensor costs on the aircraft. The author is indebted to Flight Test Associates in Tucson AZ for the $2,500 nominal estimate of direct cost per flight hour. The author estimated an additional $500 an hour to obtain the $3,000 O&M estimate. See Martha L. Willman, "Corporate Jets Adding Mileage to Bottom Line," *Los Angeles Times*, 16 May 19, 1999, sec. 1C, p. 14. The article quotes a cost of $1200/hr for a smaller aircraft (8-15,000 lb takeoff weight). According to *Jane's*, the ERJ-145 has a takeoff weight of 45,415 lbs and thus would have proportionally higher cost.

[26] Robert M. Williams estimates time on station is limited to 500-600 flight hours a year per aircraft. Generally, on station hours are one half of total flight hours. Thus total flight hours for each AEW is 1,200 hours/yr and include transit and maintenance flights. Calculations as follows:

AEW cost= Flight hours a year for each AEW * O&M flight hour cost per hour * 5 AEWs

AEW cost= 1,200 hours × $3000/ hour × 5

AEW cost= $18,000,000

[27] Interview with Robert M. Williams.

[28] "Detection and Monitoring Systems Analysis," (Miami, FL: U.S. Southern Command, May 1994, photocopied).

[29] Time on station for all five aircraft is 3,000 hours (600 flight hours × 5 AEWs). Calculations as follows:

$ESTC_{AEW}$= R (radar swath width) × L (barrier length) × TOS × P (probability of detection) × MAV (mission availability rate)

$ESTC_{AEW}$= 324 nm × 700 nm × 3000 hours × .90 × .85

$ESTC_{AEW}$=520,506,000 square nautical mile × hours

requirement for SIVAM/ FAB low altitude detection (see Table 5 on page 79).[30] In stark terms, sixty-two AEWs would be needed to cover the total low altitude space-time requirements of the Brazilian borders in the Amazon region.[31] In this case, the reference area is only the border and does not include coverage of the central Amazon region. The operations and maintenance (O&M) cost of maintaining sixty-two AEW aircraft to provide full low altitude space-time coverage of the border would be prohibitive. It would cost the Brazilian government $223 million a year.[32]

As we have seen, low altitude space-time coverage of SIVAM's GBRs and AEWs are limited. This will result in a low probability of detection of low flying small aircraft of the type used by drug smugglers. The problem is that aircraft most likely to be engaged in illegal activities (such as drug smuggling) will fly at the lowest altitudes to avoid detection. SIVAM existing aerial and ground surveillance assets will probably not adequately track these illegal aircraft.

In summary, this chapter has identified two significant SIVAM limitations. The first is organizational, and the second is architectural. SIVAM lacks a body for effective coordination and deconfliction of surveillance requirements. Safeguards to prevent surveillance abuses and prevent corruption have not yet been identified. Existing aerial and ground surveillance assets do not provide sufficient low altitude airspace coverage. This thesis will later describe how deficiencies can be mitigated with greater U.S. and Brazilian cooperation.

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[30] Calculations as follows:
ESTC requirement= ESTC $_{AEW}$ / ESTC border
ESTC requirement= 520,506,000 sq. nm hours/ 6130,598,400 sq. nm hours
ESTC requirement= .085

[31] Calculations as follows:
ESTC for each AEW= ESTC $_{AEW}$ / 5 (keeping in mind there are five SIVAM AEW aircraft)
ESTC for each AEW= 520,506,000 sq. nm year / 5 = 100,501,200 sq. nm year
AEW number required= ESTC border/ ESTC for each AEW
AEW number required= 6130,598,400 sq. nm hours / 100,501,200 sq. nm hours
AEW number required= 61 (Add one extra aircraft for training purposes= 62)

[32] Calculations as follows:
AEW cost= Flight hours a year for each AEW × O&M flight hour cost per hour × 62 AEWs
AEW cost= 1,200 hours × $3,000 × 62
AEW cost= $223,200,000

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V. SIVAM AND U.S.-BRAZILIAN MILITARY OOTW

The chapter will analyze the Brazilian military's involvement in the Amazon and with SIVAM. It will also examine U.S. geopolitical interests in the region. Some problems SIVAM detects may require Brazilian military Operations Other than War (OOTW)-type response, especially by FAB. Significant military involvement is likely, as it is increasingly likely that the ministry of defense (MOD) will oversee SIVAM.[1] Regardless of the level of Brazilian military interaction with SIVAM and thus OOTW, the United States will be able to provide assistance in future Brazilian OOTW (such as environmental degradation, counter-drug, and counter-guerrilla) via military support or intelligence sharing. Most importantly, the successful cooperative endeavor in building SIVAM could facilitate greater U.S.-Brazil military-to-military cooperation and involvement. At present, institutional level military-to-military linkages already exist between the two countries.

The military has always considered the Amazon important to Brazil's national security.[2] The military believes growing lawlessness and inadequate projection of sovereignty require a greater military presence and involvement in the region. For example, according to Jane's *International Defense Review*, SIVAM will support a strengthened military presence and reinforce the *Calha Norte* (which will be discussed in the next section) for protecting the region.[3]

Other factors reinforce the perception that the military needs to increase its regional influence.[4] One expert in the region states that, "...the military has been seeking a new role, primarily to justify its meager budget. The armed forces have seemed increasingly irrelevant, given the lack of an external threat ...[and] internal threat."[5] The military defense budget, as a percentage of gross domestic product (GDP), was one of the

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[1] Brazilian Defense Ministry officers told the author that SIVAM will be controlled by the MOD on 9 September 1999 in Brasília.
[2] William Schomberg, "UN Plans Aid for Amazon Fire Fighting," *Reuters*, 31 March 1998. Available [Lexis/Nexis]: WORLD/MEXPUB [4 August 1998].
[3] "Brazilian Forces Strengthen Amazon Borders."
[4] Mario Osava, "New Roles For Military in Health and Fire-Fighting," *Inter Press Service*, 3 April 1998 Available [Online]: <http://infoweb.newsbank.com> [27 July 1998].
[5] Tollefson, 367.

lowest in South America in the early 1990s. However, support for military presence in the region has probably contributed to a doubling of the budget since 1992 in both relative (percent of GDP) and absolute terms.[6] Despite this increase, President Fernando Henrique Cardoso's neo-liberal economic policies, with its emphasis on privatization and reducing defense expenditures, could threaten the armed forces' current roles and missions as well as budget outlays.[7]

Detection of regional problems by SIVAM will probably necessitate a military response. Hence, the military will likely be involved in future OOTW due to SIVAM detection capabilities. This is especially relevant when SIVAM detects illegal activities and the Federal Police and other governmental law agencies are unable to respond. In sum, the military will probably be heavily involved in SIVAM.

A. BRAZILIAN MILITARY AND THE AMAZON

In May 1999, the Brazilian Congress passed the law approving Brazil's first ministry of defense (MOD).[8] Senator Élcio Álvares is Brazil's first Defense Minister. His first priority was the "establishment of SIVAM, [and] the situation in the border areas."[9] This is because the MOD views the Amazon as vulnerable to outside intrusion because it is sparsely populated. The borders in the Brazilian Amazon are poorly defined and defended.[10] This has always been a concern of Brazil's military. The military is suspicious of foreign interest or involvement in the Amazon that it perceives as a threat to sovereignty in the region. Many Brazilians believe that if Brazil does not solidify control and development in the region, foreigners will. The army began implementing the Northern Corridor (*Calha Norte)* program in 1985 to strengthen security along a corridor 6,500 kilometers (3,900 miles) long and 150 kilometers (90 miles) wide along the

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[6] *The Military Balance,* 1998/99, 203.
[7] Tollefson, 410.
[8] Refer to <http://www.defesa.gov.br> for more information on the Ministry of Defense.
[9] Christiane Jungblut and Chico Otavo, "New Defense Minister Outlines Plans for Post," Rio de Janeiro O GLOBO (26 December 1998), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 29 December 1998 (FTS19981229001211).
[10] Wendy Hunter, *State and Soldier in Latin America: Redefining the Military's Role in Argentina, Brazil and Chile,* Washington DC: United States Institute of Peace, 1996, 23.

frontiers with five countries.[11] *Calha Norte* is composed of military posts, airfields, army garrisons and roads to facilitate development. In 1992, the army created a military command headquartered in Belem, Pará.[12] Since 1993, Brazil has transferred troops from the center-south, southeast (Rio de Janeiro) and south (Rio Grande do Sul) to the Amazon to protect from "internationalization of the Amazon" and justify the military budget.[13] *Calha Norte* suffers difficulties from the large size of the region and shortage of funding. However, Minister, Élcio Álvares is a strong supporter of *Calha Norte.*[14] The military's objective, which has political support, has been to fortify the security of the "resource-rich region from foreign interests."[15]

According to retired Rear Admiral Armando Amorim Ferreira Vidigal (a former commander of the Navy's War College (*Escola de Guerra Naval*- EGN)), "the Amazon region is the most probable scenario for conflict in the country."[16] Vidigal believes there is a possibility of a United Nations political intervention and pressure to either ensure the preservation of the forest, or "to declare independence for the Ianomami" Indians in the Brazilian Amazon.[17] In support, War College (*Escola Superior de Guerra*- ESG) advisor Jorge Boaventura warned that Brazil must be alert to the UN Security Council's tendency to accept the concept of "relative sovereignty" in regions that are of "interest to mankind."[18]

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[11] Rabben, 341.
[12] Hunter, 23.
[13] Wendy Hunter, *Eroding Military Influence in Brazil: Politicians Against Soldiers.* Chapel Hill: University of North Carolina Press, 1997, 134.
[14] "Defense Minister Urges Reactivation of Calha Norte," São Paulo FOLHA DE SÃO PAULO (4 September 1999), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 9 September 1999 (FTS19990909000496).
[15] Wendy Hunter, *State and Soldier in Latin America: Redefining the Military's Role in Argentina, Brazil and Chile,* 23.; Wendy Hunter, *Eroding Military Influence in Brazil: Politicians Against Soldiers.*
[16] Vidigal lectures at the Army General Staff and Command School (*Escola de Comando de Estado-Maior do Exército*-ECEME), at the Aeronautics General Staff and Command School (*Escola de Comando de Estado-Maior da Aeronáutica*-(ECEMAR) and at the War College (*Escola de Guerra*-ESG). "Brazilian Military Experts View Amazon's Vulnerability," São Paulo FOLHA DE SÃO PAULO (28 January 1996). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 5 May 1996 (FBIS-LAT-96-021).
[17] Ibid.
[18] "Relative sovereignty" has been an issue of contention in the UN Security Council (with China being a strong opponent of the concept) in 1999 as a result of NATO intervention in Kosovo and UN forces in East Timor. Ibid.

According to Boaventura, "The Amazon region is extremely coveted as a source of mineral and natural reserves by countries that have great importance in the conduct of international affairs."[19] Boaventura also emphasizes the need for Brazil to have complete control of its airspace. This emphasis is a common theme of concern within the leadership in the Brazilian armed forces. In a 1996 article in *Military Review*, Brazilian Army Colonel Álvaro de Souza Pinheiro expressed concern over a statement made by former French President Francois Mitterand at the 1991 Non-Governmental Agency (NGO) World conference "...alluding to the *devoir d'ingerence* (right of intervention) of the world community in the protection of the environment, suggesting the creation of a supranational guardian authority."[20]

The military also had concerns regarding the 1993 joint U.S.-Guyana exercises.[21] The 1996 Third National Meeting report of Strategic Studies was developed from conclusions of military leaders, congressmen, executives, and mining leaders in debates at Petrobrás headquarters. At the meeting, the military also expressed opposition to the continued establishment of indigenous reservations in border areas.[22] The report stated Brazilian sovereignty in the Amazon is threatened and suggested greater military defense of the area.[23] As a result, General Alberto Cardoso, chief military liaison to Fernando Henrique Cardoso, announced that the military had a new National Defense Policy to redirect resources to the rainforest in the north.[24] In 1997, the army developed a new doctrine for the use of forces in the Amazon region, against internal and external enemies. It is known as the "Gamma Doctrine for Jungle Operations".[25] The doctrine

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[19] Ibid.
[20] Alvaro de Souza Pinheiro, "Guerrillas in the Brazilian Amazon." *Military Review* 76, no. 2 (1996): 53.
[21] Tollefson, 368.
[22] "International Greed' for Amazon Region, Other Strategic Issues Discussed," *Jornal do Brasil* [Rio de Janeiro] provided by BBC Monitoring Service, 26 October 1996. Available [Lexis/Nexis]: WORLD/TXTCSD [4 August 1998].
[23] Ibid.
[24] Michael Christie, "Brazil: Brazil's Military to Fight for Ecological Image," *Reuters,* 14 November 1996. Available [Lexis/Nexis]: WORLD/TXTCSD [4 August 1998].
[25] "Brazil: Army Updates Military Strategy for Amazon Region," *Folha de São Paulo* provided by BBC Monitoring Service, 30 April 1997. Available [Lexis/Nexis]: WORLD/TXTCSD [4 August 1998].

defines how larger units such as divisions, brigades and battalions will operate in the jungle.[26]

Today the army has four brigades in the Amazon consisting of 2,000-5,000 men each, and plans to increase the number of troops by transferring more units stationed in the south and southeast.[27] Brazil plans to deploy at least five more battalions in the border areas of Colombia, Venezuela, Suriname and French Guyana in 1999. This will bring the total number of army units to eighty.[28] Regarding deployments and command and control, the state of Amazonas is critical due to its centrality and size. For example, the Military Command of the Amazon in Manaus controls all the military units in the whole Brazilian Amazon.[29] The army is also building an army airbase in Manaus to transport troops by helicopter and to decrease reliance on FAB installations and transport.

In 1998, the army's strong sense of sovereignty was probably a significant factor in their blocking UN assistance during the unprecedented large forest fires in the state of Roraima. Army General Luiz Edmundo Carvalho, First Jungle Infantry Brigade commander, opposed UN aid and personnel to help fight the fires.[30] Instead, Brazilian soldiers were brought to fight the vast burns. However, due to the size and gravity of the fires, Brazil accepted five hundred firefighters from Venezuela and Argentina. Presidential spokesman Sergio Amaral remarked at the time of the fires that, "The government position regarding this case is that some countries really have more experience and technology in combatting fires, and all international help from specialists coordinated by the Brazilian government will be welcome."[31] General Carvalho was placed in charge of all fire-fighting efforts. Fortuitously, heavy rains extinguished the

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[26] The author could not locate documents pertaining to a joint Army, Navy and Air Force strategy for defense of the Amazon.
[27] Ibid.
[28] Edson Luiz, "Army to Strengthen Presence in Amazon Region," São Paulo O ESTADO DE SÃO PAULO (6 December 1998), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 7 December 1998 (FTS19981207001634).
[29] Mendel.
[30] Laurie Goering, "In Amazon Fires, Brazil Accepts Aid; Military Usually Suspicious," *Austin American-Statesman,* 28 March 1998, Available [Lexis/Nexis]: REGNWS/CURNWS [4 August 1998].
[31] Edson Luiz and Tania Monteiro, "Government, Military at Odds Over UN Aid to Fight Fires," São Paulo AGENCIA ESTADO (28 March 1998). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 29 March 1998 (FBIS-TEN-98-084).

fires on 31 March 1998.[32] Later that year, the European Union (EU) Parliament criticized Brazil for an inadequate response to fires.[33] The areas ripe for criticism regarding Brazil's overall response to the fires were: 1) a central command to fight fires was not established early on; and 2) response actions by various federal entities including the army, FAB, IBAMA, and Federal police were uncoordinated and often in conflict.[34]

Brazil might have learned much from the near debacle in March 1998. A large fire was detected by satellite near the Indian reservation within the Xingu National Park in the state of Mato Grosso in September 1998. President Cardoso, who was widely criticized for the slow and often uncoordinated federal response to the fires in March, quickly allocated $13 million, and directed the army to provide logistical support, for the FAB to transport firemen into the region.[35] The World Bank also announced a $15 million emergency disbursement to fight these fires.[36] Once SIVAM is in place, it will undoubtedly be able to support military efforts in combating future fires and other natural disasters.

B. SIVAM, THE MILITARY, AND OOTW

The military, through the ministry of defense, is closely linked to SIVAM. As stated earlier, the President of CCSIVAM is an air force general (*Brigadeiro* José Orlando Bellon).[37] SIVAM will have the capability to conduct a wide variety of different surveillance tasks. SIVAM's multiple uses and the demands they will place on the system will have to be prioritized due to finite resources and personnel. Overall, the system will have the capability to support routine regional development while at the same

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[32] Ibid., See also Anthony Faiola. See William Schomberg, "UN Plans Aid for Amazon Fire-fighting."
[33] "Dispute With European Parliament Over Amazon Fire," São Paulo FOLHA DE SÃO PAULO (3 June 1998). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 4 June 1998) (FBIS-TEN-98-154).
[34] William Franca, "Government Trying to Coordinate Actions in Roraima," São Paulo FOLHA DE SÃO PAULO (27 March 1998). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America:* 30 March 1998 (FBIS-TEN-98-086).
[35] William Schomberg, "Brazil Flies in Firemen to Protect Indian Park," *Reuters,* 1 September 1998, Available [Online]: <http://infoweb.newsbank.com> [2 September 1998].
[36] Diana Jean Schemo, "Fires Posing Greater Risk as Amazon Rain Forest Grows Drier," *New York Times,* 13 September 1998.

time provide support to the military. While SIVAM will probably be used to locate timber, mineral and oil resources more efficiently during peacetime, it will also support the military in its efforts to gain greater control of the territory.[38] The most likely area it will support the Brazilian armed forces is the often-nebulous area of OOTW. For example, air force, army and commercial aviation will benefit from better air traffic control (ATC), the army will benefit from overall geographical and threat intelligence (especially in border areas), and the navy will gain greater intelligence of the Amazon River and its thousands of tributaries. All services will benefit from SIVAM surveillance, especially to support operations against drug and mineral traffickers, illegal loggers and miners, unauthorized incursions into Brazil, and large forest fires.

Despite the fact that CCSIVAM maintains that the government does not want to militarize SIVAM, many SIVAM functions will directly support military OOTW.[39] SIVAM support to Brazilian OOTW could create opportunities for U.S. military or non-military support at Brazil's request, especially if domestic resources are exhausted.

The underlying purpose for SIVAM seems to be to act as an instrument of regional control by the military. SIVAM has a strong Electronic Warfare (EW) capability that will serve it well in this purpose. According to the *Journal of Electronic Defense*, despite South America's relative lack of militarization, "the region probably experiences as much operational EW activity on a daily basis as such hot spots as Northern Iraq, Bosnia and the Korean DMZ."[40] The reason for this is the high level of OOTW in the region, especially in the counter-drug and counter-guerrilla arenas. It is also hard to physically monitor low-threat border regions. The journal states that, "The low intensity nature of the Latin American threat environment creates a larger demand for SIGINT, radar and surveillance technologies."[41] There is a high demand for equipment capable of penetrating dense jungle and mountain terrain to track movement

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[37] As stated earlier, as a result of the July 1999 cabinet reorganization, portions or all of SIVAM may fall under the new Defense Ministry.
[38] Allen.
[39] Hunter asserts that the U.S. and Japanese governments perceive SIVAM as mainly a military and not an environmental project. Wendy Hunter, "Eroding Military Influence in Brazil: Politicians Against Soldiers"; Interview with Albuquerque Neto.
[40] Lum.
[41] Ibid.

of inter-state threats (foreign militaries), intra-state threats from insurgent guerrilla groups, natural-resource smugglers, and drug-traffickers.[42] Architectures with EW capabilities such as SIVAM help militaries in the region project sovereignty of their nation's borders as well as the ability to counter threats due to internal conflicts, environmental "opportunists," drug traffickers and ecological degradation.[43]

C. SIVAM, THE U.S MILITARY, AND OOTW COOPERATION

Two crucial missions of the military is to maintain sovereignty and to support combatting transnational drug trafficking. These missions, which fall with OOTW, will be greatly aided by utilization of the Shoot-down Law (law 9614) passed in 1998. The law will only be implemented when Aeronautics Command defines shoot-down rules of engagement. The timeframe for the law's implementation has not yet been announced. Once the law goes into effect, it will permit the FAB to shoot down aircraft attempting to smuggle drugs. FAB will execute the missions with its ALX aircraft. SIVAM will inevitably be used as a tool for locating smuggling aircraft and thus enforcing law 9614. According to the Chief of the Military Household, General Alberto Cardoso, this law should dissuade illegal flights from entering the country in the future. [44] This law was passed due to the large numbers of aircraft using the Brazilian Amazon as a corridor for smuggling drugs (Chapter II details this problem). If cooperation is extant, the U.S. may be able to help Brazil track aircraft in the region or aircraft that escape the Brazilian net (the thesis later describes how United States can support this effort). Regardless of the level of cooperation achieved between the U.S. and Brazil in interdiction, SIVAM's role will indirectly support the U.S.'s counter-drug efforts in the region by helping to stem the transit of drugs from source regions. This is important to the United States government, particularly with closure of U.S. bases in Panama in 1999, to include the Howard AFB counter-drug facility.

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[42] Ibid.
[43] Ibid.
[44] Cardoso also heads the Sub-secretary of Intelligence (*Subsecretaria de Inteligencia*- SSI), which implies some intelligence participation in the process. See William Schomberg, "Brazil Ready to Shoot Down

Another significant gray area threat to the military is the alliance between drug traffickers and guerrillas in the greater Amazon region. This concern is also shared by the U.S. government and military forces deployed south. For example, Brazilian Colonel Souza Pinheiro warns of the danger of an increasingly

> strong connection between foreign guerrillas and drug traffickers which create the phenomena of narco-guerrillas (particularly in Peru and Colombia). This situation presents the possibility of escalating crises which have the potential to unleash threats to the vital interest of Brazil in the Amazon. This especially concerns the sovereignty and territorial integrity of national patrimony.[45]

The Brazilian military has also received reports of incursions by insurgents and narco-guerrillas from neighboring countries into the Brazilian Amazon. This threat is the most serious and difficult OOTW facing the Brazilian military. Further, the Brazilian military is investigating statements by Peru's President Alberto Fujimori that the Peruvian Shining Path guerrillas have built a supply base in Acre (located near the borders with Peru and Colombia).[46] Therefore, the building of SIVAM is, in part, a response to Brazil's fear that narco-guerrilla activities in the Amazon will become irreversible and permanently threaten its sovereignty. The head of the SAE probably referenced this threat when he stated in 1995 that SIVAM will be used to "plan strategic and emergency actions."[47]

In sum, SIVAM will be an important tool in supporting Brazil's military counter-guerrilla and counter-drug OOTW. Traditionally Brazil employed the Federal Police, with its constitutional mandate, to lead the counter-drug effort. It used the military mainly for logistical support. This was due to fears that traffickers would destabilize democracy by corrupting the military.[48] However, there are indications that the military

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Drug Planes," *Reuters,* 5 March 1998. Available [Online]: <http://infoweb.newsbank.com> [17 November 1998].

[45] Alvaro de Souza Pinheiro, "Guerrillas in the Brazilian Amazon." *Military Review* 76, no. 2 (1996): 53.

[46] "Brazil Investigates Guerrilla Infiltration," *Jane's Defense Weekly* 32, no.2 (14 July 1999): 8; Francisco Leali, "Military Deployed to Amazon Border With Peru," Rio de Janeiro JORNAL DO BRASIL(4 July 1999), Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 6 July 1999 (FTS19990706001801).

[47] "Military Concept of Development of Amazon Region Reported to Have Changed," *Folha de São Paulo* [São Paulo] provided by BBC Monitoring Service, 28 January 1995, Available [Lexis/Nexis]: WORLD/TXTCSA [10 October 1998].

[48] Ibid.

is playing a more active role in Brazil's counter-drug war, especially with FAB's likely involvement in shoot-downs.[49]

Another reason the military is taking on counter-drug OOTW is that the Federal Police, with its limited resources, is increasingly overwhelmed by the drug-trafficking problem. For example, the military has deployed army units from southern Brazil to the region's borders in order to counter the drug threat and tighten borders. In fact, this new responsibility has increased rapidly according to the former assistant U.S. military attaché to Brazil as a result of inadequate Federal Police resources.[50] Due in part to this increase in Brazilian military's role in counter-drug missions, General Benedito Bezerra Leonel, chief of the Armed Forces General Staff (*Estado Maior das Forças Armadas*- EMFA), stated in 1997 that he supported Brazilian military support to counter-drug operations in the areas of "...supplying information, by disclosing flight data registered through radar, or by providing logistical support like transport and lodgings in remote areas."[51] Institutionally, the military already has a significant role in counter-drug missions. General Alberto Cardoso heads the National Anti-drug System (*Sistema Nacional de Antidrogas*- SISNAD). SISNAD combats drug trafficking in coordination with the civilian led SENAD. For example, according to *Correio Braziliense* in July 1998, the armed forces intelligence services will support counter-drug efforts, as well as provide special operation troops in OOTW against drug trafficking in the Amazon region.[52]

The United States is also concern with Brazil's drug-trafficking problem. Shared concerns could create conditions for cooperation between the two countries in counter-guerrilla and counter-drug OOTW, especially if Brazil finds its domestic resources are insufficient to respond. Raytheon's successful participation in implementing SIVAM, as

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[49] Hugo Marques, "Destruição de Aeronaves Hostis Terá que ser Filmada," *O Globo* (Rio de Janeiro), 15 October 1998.

[50] Neil P. Krukar, Col. USA, Political Military Officer- Western Hemisphere Bureau, Interview by author, 4 May 1999, Washington D.C., U.S. Department of State.

[51] Jorge Luiz Souza, "Brazil 'Resisting' U.S. Pressure in Drug Struggle," São Paulo, GAZETA MERCANTIL (9 October 1996). Translation by the Foreign Broadcast Information Service. *FBIS Daily Report—Latin America;* 25 April 1997 (FTS19970425001686).

[52] "New Drug Czar Expands on Senad Objectives," Brasília CORREIO BRAZILIENSE (24 July 1998), Translation by the Foreign Broadcast Information Service, *FBIS Daily Report—Latin America;* 27 July 1998 (FTS19980727001164).

a non-state actor, can be a bridge for cooperation, especially when Brazil perceives that SIVAM or other military monitoring systems might be modernized or made better.

In summary, Brazilian OOTW missions (e.g., counter-drug) supported by SIVAM will most likely increase due to better monitoring of the Brazilian Amazon. The United States is already supporting counter-drug OOTW operations in the Carribean and in the Andean region. Thus, U.S. and Brazilian militaries form the best avenue for cooperation in OOTW. Raytheon's participation in SIVAM already establishes a greater linkage between the United States and Brazil. SIVAM provides a means for Brazil to overcome traditional sovereignty concerns and thus increase U.S. and regional cooperation. This cooperation can be used to satisfy overlapping interests of both the United States and Brazil. Hence, SIVAM is capable of supporting U.S. and Brazilian OOTW. Successful execution of these missions, whether employing SIVAM or ROTHR data create opportunities for greater cooperation between the two nations. Chapter VI will explore how SIVAM, with U.S. help, can be improved to better reinforce Brazil's sovereign borders while simultaneously supporting U.S. national interests in the region.

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VI. IMPROVING SIVAM CAPABILITIES, AND U.S.-BRAZILIAN COOPERATION

This chapter considers how SIVAM can be improved by stronger cooperation between the United States and Brazil. SIVAM's organization and architecture can be improved by 1) creating a capable coordinating body; 2) instituting proper oversight over that body; and 3) acquiring a SIVAM Relocatable Over the Horizon Radar (ROTHR) as well as integrating ROTHR coverage from the United States.

The first measure of creating a coordinating body would ensure an effective functioning of the architecture. Such a body would also be institutionally prepared to handle regional crisis in the greater Amazon region, including those crises where possible involvement of nations contiguous (as well as the United States) to Brazil might occur.

The latter two measures— instituting oversight and acquiring a ROTHR— can be effectively implemented by U.S.-Brazil cooperative efforts. This is especially so with acquiring a SIVAM ROTHR and sharing OTH radar data between the two nations. SIVAM can improve its surveillance by being complemented by its own ROTHR. A SIVAM ROTHR would complement SIVAM's surveillance capabilities by providing it with large area low altitude surveillance. This surveillance would help strengthen Brazil's sovereign borders as well as provide it a tool for regional leadership on issues such as counter-drug initiatives. CCSIVAM should consider working with Raytheon to conduct technical and operational feasibility studies for a SIVAM ROTHR.[1] CCSIVAM might also consider acquiring data covering the Amazon region from the U.S.'s ROTHR in Puerto Rico. A Brazilian SIVAM ROTHR would be a valuable adjunct to GBR and AEW low altitude coverage. Taking into account degradation from equatorial ionospheric anomalies, ROTHR could still provide, on average, seventy percent

[1] The following were interviewed by the author: Ralph Utley, Captain U.S. Coast Guard, Executive Director, Interview by author, 14 September 1999, Washington D.C., United States Interdiction Coordinator; Andrew I Rudman, Brazil Desk Officer, Interview by author, 14 September 1999, Washington D.C., U.S. Department of State; Joe Furloni, Director- Bureau of International Narcotics and Law Enforcement Affairs, Interview by author, 15 September 1999,Washington D.C., State Department; Dennis W. Hearne, First Secretary, Interview by author, 10 September 1999, Brasília, Embassy of the United States.

probability of detection of low altitude aircraft in the region. As a complementary[2] surveillance system, ROTHR would provide approximately ten times more space-time coverage than SIVAM's combined AEW and GBR systems in the Colombia-to-Bolivia border area.[3] ROTHR could provide 114 percent of the ESTC requirement for the border. The operating costs of covering the Brazilian border area is approximately one U.S. dollar per hour for each one thousand square nautical miles of low altitude coverage. By contrast, the comparable cost-effectiveness for AEWs and GBRs is $346 and $565 per hour, respectively (see Table 5, page 79).

A. ORGANIZATIONAL RECOMMENDATIONS

1. Establishing an Effective Coordinating Body

SIVAM requires an overarching coordinating body that can effectively prioritize, deconflict and manage surveillance requirements from many agencies efficiently. As currently planned, SIPAM, a policy monitoring body, is tasked to have oversight of SIVAM once it becomes operational. One could argue that this plan, as well as SIPAM in general, does not provide the most efficacious oversight mechanism. SIPAM should probably not be the coordinating body for several reasons. First, it is not adequately manned for this function. Second, its high-level strategic view of the region would not be compatible with tactical SIVAM daily operations. Third, it would probably not have sufficient political clout to handle political challenges to SIVAM.[4] It would probably be best if the body were sufficiently powerful, as to not be dominated by one of its customer agencies. Yet, it should probably not be so powerful that it would not to be subject to controls and oversight. The agency would benefit from encouraging cooperation and negotiating disagreements between Brazilian government customers. The coordinating body should also encourage intelligence sharing. The body would probably function best if it were co-located with SIVAM's CCG center of power in Brasília. The coordinating

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[2] Tim Carey, Deputy Manager SIVAM- Raytheon Electronic System, Telephone interview by author, 13 September 1999, Bedford Massachusetts, Raytheon Corporation. He emphasizes that ROTHR could complement SIVAM, but not replace its existing surveillance architecture.
[3] ROTHR covers 112 percent of Brazil's border (Colombia to Bolivia) time-space needs, while AEWs 8.5 percent and GBRs only 2.9 percent. See "Proposed Solution for Low Altitude Coverage" section.
[4] Interview with Albuquerque Neto.

body would be in the best position to perform the difficult task of handling requirements from a large number of customers, each with its own set of interests.

The Minister of Science and Technology (Ronaldo Sardenberg), along with the Defense Minister (Élciu Álvares) might consider jointly presiding over the coordinating body. ATECH engineers could capably fill many of the technical and operational day-to-day requirements of such a body due to their intimate knowledge of SIVAM's architecture and capabilities.[5] Each of the major governmental agencies that would be customers for SIVAM should have representatives in the body.

The coordinating body should be required to resolve challenges such as prioritizing multiple requirements. For example, it can be argued that each agency will push its own operational requirements and tasks to be met by SIVAM without necessarily considering what is best for the nation as a whole. They may also want to task their "favorite" surveillance asset toward their "pet" requirement. Instead, the coordinating body should determine what assets to employ based on a prioritized list of requirements with a strategic view of what is important for the region. For example, there may be situations where several requirements by various Brazilian agencies can be best met by only one available sensor such as the ERJ-145RS surface surveillance aircraft. SIVAM will have three ERJ-145RS jets that carry a Synthetic Aperture Radar (SAR) camera, a Moving Target Indicator (MTI) sensor, an optical and forward looking infrared (FLIR) television sensor, a Multi-spectral System (MSS), and Communications/ Non-Communications Exploitation Sensor (C/NCES). For example, in a given period:

1) The Federal Police may want to determine if a clandestine airfield is active with the FLIR.
2) The army may request the FLIR to locate a suspected Colombian guerrilla incursion near the border.
3) SENAD may ask the Federal Police to monitor communications (using C/NCES) of a suspected clandestine drug lab that is known to use radios.
4) The Ministry of Mines and Energy may request a SAR and MSS survey of an alleged high content mineral area.

[5] Recall the description of ATECH in Chapter III.

5) The navy may want to use the ground MTI to locate boat activity on an Amazon River tributary.

The coordinating body will have to decide which of these five requirements will have priority, as well as whether the other tasks hypothetically outlined above can be met by other means.

The coordinating agency should also be structured to allow for increased regional and international cooperation within the established SIVAM organization. It can be argued that the main benefit to Brazil would be that the agency would be institutionally configured for regional coordination during crisis, while ensuring Brazilian sovereign control over the region. For instance, SIVAM should nominate/ identify on-call liaison personnel from certain U.S., Argentine, Chilean, Bolivian, Peruvian, Colombian and, Venezuelan counterparts of major Brazilian agencies. U.S. agencies that could support SIVAM include the Environmental Protection Agency (EPA), Federal Aviation Administration (FAA), Office of Foreign Disaster Assistance (OFDA), Drug Enforcement Agency (DEA), Department of Defense (DOD), National Oceanic and Atmospheric Agency (NOAA), and National Air and Space Agency (NASA).

Plans should also be developed for on-call liaison personnel with selected national and international scientific bodies and non-governmental organizations (NGO). Liaison personnel from these entities would facilitate coordination in crises such as that of the Amazon fires in 1998.

SIVAM will inevitably increase international awareness of problems in the region. Additionally, the Puerto Rico ROTHR will monitor, in a single coverage basis, low altitude flights in the Amazon providing the Americans an awareness of activity in the region. Thus, it would be prudent for the government of Brazil to allow foreign or regional involvement and assistance on its own terms as a regional leader. This proposal may not be easy to implement given Brazil's long-standing sovereignty concerns described in Chapter II. However, the implementation of these recommendations will probably help Brazil integrate the region in its own terms, as Brazil will have control of regional efforts in its territory.

2. Underlying Rationale for Oversight of SIVAM

The coordinating body, as outlined above, should be subject to executive and legislative oversight. Oversight of SIVAM operations protects against two dangers: 1) abuse of Brazilian personal freedoms; and 2) abuse from corruption. Recently, corruption from influence of drug-traffickers has become a serious issue in the region, (e.g., the recent example of drug trafficking in FAB aircraft discussed in Chapter IV). Therefore, it is in the government's interest to ensure that Brazilians see SIVAM as capable and trustworthy, because SIVAM will have an array of powerful surveillance assets capable of gathering information on private citizens. These assets include communications intercept and imaging capabilities. For example, the government's accounting arm in the judicial branch (*Tribunal de Contas da União*- TCU) is now required to conduct yearly audits to ensure there is no corruption in SIVAM's contract execution. TCU, with legal authority of judges, should also be charged with ensuring that proper search warrants are issued for intelligence gathering of private citizens and their properties. An effective oversight committee whose main aim is to protect personal liberties (such as right to privacy) will help maintain trust. A separate oversight body from either congress or ministry of defense, civilian agencies, and joint military service representatives could also assist in this task. This oversight body should also periodically oversee collection procedures to ensure they are not abused.

Protection of SIVAM from corruption, especially in the area of drug enforcement, is especially important for two reasons. First, the Federal Police publicly admitted that it is currently having problems combating drug trafficking.[6] Second, there are emerging signs of some military involvement in narco trafficking.[7] Since one of SIVAM's key functions is to surveil north and northwest Brazil to support counter-drug efforts, a body to monitor corruption and illegal activities within SIVAM and the agencies it supports should be established.

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[6] Hugo Marques.
[7] Interview with Krukar.

B. IMPROVING COVERAGE COOPERATIVELY

Increased cooperation with the United States will also facilitate improving SIVAM's surveillance capabilities to the degree that it would help Brazil become a regional leader in issues such as counter-drug cooperation. For this to happen, SIVAM surveillance should be capable of performing two functions: detection of problems and supporting countermeasures. If CCSIVAM were to incorporate a Brazilian based ROTHR into the SIVAM architecture, SIVAM would be able to better cover low altitude airspace in the region as well as help it perform both functions. CCSIVAM should concurrently negotiate with the United States to integrate Puerto Rico ROTHR data that covers the Amazon into SIVAM surveillance activities so as to enable dual coverage. A Brazilian ROTHR would provide usable synoptic low altitude detection capability in the Amazon region, even given some degradation from the equatorial ionosphere which will be described below. One should keep in mind that Brazil is already considering expanding SIVAM's radar coverage to its coastline in a project called SIVAMAR.[8]

1. Overview of ROTHR[9]

Aviation Week and Space Technology describes ROTHR as a bistatic, ionospheric backscatter high frequency (HF) Doppler radar system that can track aircraft and some ships. It was originally developed by Raytheon to track incoming missiles and bombers during the Cold War. Since then, significant improvements and upgrades have been made to optimize a ROTHR's ability to detect smaller maneuverable aircraft in a counter-drug role by the United States. ROTHR uses the ionosphere to reflect an HF signal so as to detect aircraft over the horizon at any altitude. The 200-kilowatt radar has an eighty

[8] SIVAMAR is a project jointly developed by the University of São Paulo and the Federal University of Rio de Janeiro to establish radar coverage, linked by satellites, of coastlines for environmental protection and oil exploration. See Irany Tereza, "ANP Cancela Registro de 21 Distribuidoras,"*O Estado de São Paulo* [São Paulo] 10 July 1999, Available [Online]: <http://www.estado.com.br/search/form-jornal.html> [27 July 1999].

[9] Jack Buckingham, ROTHR Program Manager N603, Interview by author, 2 September 1999, Dahlgren VA, Naval Space Command; Shannon Doyle, Lt USN, Operations Officer, Interview by author 3 September 1999, Chesapeake VA, Fleet Surveillance Support Command. The author was given a tour of the Virginia ROTHR transmit and receive sites.

degree wide illuminated sector fan capable of covering 1.6 million square miles at the 5 and 28 megahertz frequencies. It has a minimum range of 1800 nautical miles, but quality of coverage varies with ionospheric conditions (see figure 7, page 77). ROTHR has the capability to spotlight specific regions to detect targets of interest. U.S. ROTHRs also have one Operation Control Center (OCC) which serves as the "nerve center" of the system by processing target information.[10]

There are two ROTHRs installed in the United States. One was installed in the Chesapeake Bay region of Virginia in 1993 and the other near Corpus Christi, Texas in 1995.[11] The United States uses the two ROTHRs to provide dual radar coverage to detect drug smuggling aircraft in the Caribbean Basin. Dual overlapping ROTHR coverage maximizes system capability. It "...facilitate(s) detection of targets with low apparent Doppler (i.e. those traveling perpendicular to the radar's line of sight)."[12] Dual coverage mitigates ionospheric degradation from equatorial anomalies because each ROTHR uses separate ionospheres (see "Potential Problems with ROTHR" below for more on anomalies). Dual coverage prevents aerial drug smugglers from surmising patterns of poor coverage, over time, by one ROTHR.[13] The U.S. sees dual coverage of the Caribbean basin by the Virginia and Puerto Rico ROTHRs as important for these reasons.

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[10] See note 15 for more on spotlight coverage. "ROTHR program office, Navy Space Command; "Interdiction Efforts In the Caribbean and Eastern Pacific," *GAO/NSIAD Report on Drug Control* 98, no. 30, 15 October 1997, Available [Online]: <http://www.access.gpo.gov/su_docs/aces/aces140.html> [20 May 1999].; "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," *Federal Register* 63, no. 31, Washington D.C., (17 February 1998): 7764. ; "Virginia ROTHR System Covers Caribbean Drug Smuggling Routes," *Aviation Week and Space Technology* 131, no. 22 (27 November 1989): 76-8; "Relocatable OTH Radar (AN/TPS-71)," *Jane's C4I Systems 1998-99,* London: Jane's Information Group, 1998.; David Hughes, "Navy Installs ROTHR System in Alaska to Protect Battle Groups in Pacific; Virginia ROTHR System Covers Caribbean Drug Smuggling Routes," *Aviation Week and Space Technology* 131, no. 22 (27 November 1989), 69-71.; "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," 7764.

[11] Ibid.

[12] "Application of Over the Horizon (OTH) Radar Technology to the SIVAM Program," (Sudbury, MA: Raytheon, Defense Systems Segment Naval and Maritime Systems, ROTHR Program Office, 13 October 1995, photocopied), 4.

[13] Rasler W. Smith, "Low Latitude Ionospheric Effects on Radiowave Propagation." Ph.D. diss., Naval Postgraduate School, 1998; Rasler W. Smith, Assistant Research Professor for Electrical Engineering, Interview by author, 22 May 1999, Monterey, CA, Naval Postgraduate School.

The United States is building a third ROTHR in Puerto Rico. It will be operational in early 2000.[14] The *Federal Register* identifies the use of existing ROTHRs and explains how the third ROTHR in Puerto Rico assists in counter narcotics efforts in the United States:

> The existing ROTHR systems in Virginia and Texas provide incomplete coverage of the South American source countries, Peru, Bolivia and Colombia, resulting in gaps that are exploited by drug traffickers. Implementation of the ROTHR system in Puerto Rico, which will complement the two existing ROTHR systems, will provide virtually complete coverage of this area... Existing ROTHR systems in Virginia and Texas have already demonstrated the ability to reliably detect, track, and aid in the interception of light civil aircraft of the type used by drug traffickers, however the Virginia and Texas ROTHR systems and other surveillance methods provide incomplete coverage of the South American source countries, resulting in gaps that are exploited by drug traffickers.[15]

Brian Sheridan, the former Deputy Assistant Secretary of Defense for Drug Enforcement Policy and Support, stated that ROTHRs have exceeded expectations in the counter-drug arena.[16] Sheridan indicated in 1995 that the decision to reduce reliance on E-3 AEW and U.S. Navy Aegis cruisers by replacing them with ROTHRs was an effective operational policy change against drug smuggling in the Caribbean Basin

According to *Jane's*, the Puerto Rico ROTHR will probably extend U.S. low altitude surveillance capabilities to source zone countries such as Colombia, Peru and most of Bolivia.[17] The Puerto Rico ROTHR will likely illuminate a significant portion of the Brazilian Amazon as well, although only on a single coverage basis (see Figure 7).

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[14] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," *Federal Register* 63, no. 31, Washington D.C., (17 February 1998): 7764.

[15] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," 7764.

[16] "Mobile Sensors Shine in Drug War," *Jane's Defense Weekly* 22, no 8 (27 August 1994): 19.

2. Improving SIVAM with its own ROTHR

A Brazilian-based ROTHR as a complement to SIVAM's GBRs and AEWs, would help tighten Brazil's airspace and maintain national sovereignty. Considering limited space-time coverage of AEWs and GBRs discussed in Chapter IV, it makes sense to employ a large area synoptic radar capable of cost effective large space-time coverage. The ROTHR could be used to detect illegal flights, especially narcotics-related violations

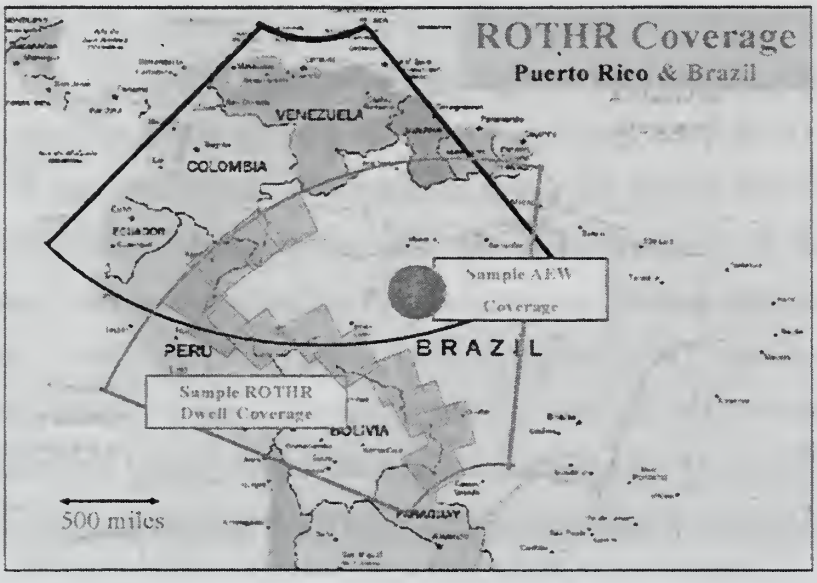

Figure 7. Hypothetical ROTHR and AEW Coverage Areas After Jane's and Aviation Week and Space Technology and author's overlay.[18]

into Brazil's airspace. It could potentially provide data on low altitude aircraft flying under and around GBRs coverage areas. The data could be used to rapidly vector Brazilian Air Force (FAB) interceptors such as the Super Tucano ALX. ROTHR could improve SIVAM aircraft surveillance and cut operating costs by assisting in pre-mission planning for ERJ-145 AEW aircraft. This ROTHR would make the AEW aircraft's limited (and expensive) TOS flight hours more effective.

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[17] Ibid.

[18] Author derived approximate dimensions of ROTHR range fan from David Hughes, 80; "AN/TPS-71 Relocatable Over-The-Horizon Backscatter (OTH-B) Radar," *Jane's Radar and Electronic Warfare Systems 1998-99,* London: Jane's Information Group, 1998. Southern ROTHR location is hypothetical. Map is a 1:35 million-scale CIA graphic.

ROTHR's greatest strength is its large space-time coverage of low altitude airspace, especially when compared with AEW and GBR.[19] A Brazil ROTHR would have an ESTC of almost 7 billion square nautical miles × hours with a seventy percent probability of detection (note that area measurement is made with the time dimension-hence the "miles × hours").[20] This represents 114 percent of ESTC requirement for the border, or more than complete space-time coverage.[21] (Recall that GBRs satisfied only 2.9 percent of ESTC requirements and AEWs 8.5 percent (see Table 5, page 79)). Note that probability of detection is an average based on analysis done to date for a ROTHR covering the Amazon region.[22] ROTHR can be degraded to 62 percent by ionospheric conditions and still fully satisfy border ESTC requirements.[23]

On an O&M cost basis, a Brazilian ROTHR would be a more cost effective means of low altitude space-time coverage in the border area than AEWs and GBRs (also see Table 5). This is the case even when factoring in decreased probability of detection of low altitude aircraft due to degradation caused by ionospheric disturbances in the equatorial belt. The following nominal annual O&M cost figures, based on U.S. ROTHRs and other systems can be employed to assert that a Brazilian ROTHR would cost $10 million,[24] in comparison to SIVAM's GBR cost of $100 million,[25]and AEW cost of $18 million. Table 5 shows how ROTHR provides cost effective coverage while

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[19] Note that when making comparisons, ROTHR should never be seen as a *substitute* for other SIVAM surveillance assets, but instead as a *complement.* This because a ROTHR cannot rival GBRs and AEWs for accuracy and reliability (see section on Potential Problems below).

[20] See David Hughes, 73. There are 176 dwell information regions (DIRS) of which ROTHR can cover up to 12 DIRS at a time. DIRS vary in size depending on how far they are to transmitter. A DIR in the middle of the coverage area covers 100,000 sq. nm. Thus we will use this as the average size of a DIR. Assuming an operational availability rate (OVR) of 95% and a probability of detection (Pd) of 70%, calculations as follows:

ESTC rothr= DIR size * DIRS covered * hours * days * OVR * Pd
ESTC rothr= 100,000 sq. nm * 12 * 24 hrs * 365 days * .95 * .70
ESTC rothr= 6990,480,000 sq. nm hours

[21] Calculations as follows:

ESTC requirement= ESTC rothr/ ESTC border
ESTC requirement= 6990,480,000 sq. nm hours/ 6130,598,400 sq. nm hours
ESTC requirement= 1.14

[22] Interview with Robert M. Williams.

[23] Calculations as follows:

100% ESTC requirement with degraded Pd= ESTC full/ ESTC excess * Pd= 1 / 1.14 * .7= .625

[24] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," 7766.

being the only asset that fully satisfies low altitude coverage in the border area even with some performance degradation. Again, this is not to say that ROTHR should replace SIVAM's AEWs or GBRs, but instead complement them.

A further advantage to Brazil of employing a ROTHR within the SIVAM architecture is that it creates an opportunity for a mutually beneficial partnership with the United States and helps it be a regional cooperative leader. For example, Brazil could negotiate to receive data from Puerto Rico ROTHR that covers the Amazon. Brazil could

Asset	Percent of Space-Time Filled	O&M Cost (USD) per 1,000 sq. nm x hour[26]
ROTHR	112	1
AEWs	8.5	346
GBRs	2.9	565

Table 5. Low Altitude Space-Time Border Coverage and Cost Comparison[27] From author's calculations, costs are in U.S. dollars.

also negotiate for U.S. assistance and support in the process of acquiring its own ROTHR. In exchange, SIVAM ROTHR data could be made available to the United States on a selective basis, or it could be swapped for Puerto Rico ROTHR data. This

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[25] Interview with Robert M. Williams. Recall there are twenty GBRs supporting SIVAM, each costing $5 million. This figure is based on similar commercial GBR systems utilized by the U.S. government.

[26] The author used a 1,000 sq. nm area for cost for ease of understanding.

[27] Calculations as follows:

ROTHR cost= O&M / ESTC rothr
ROTHR cost= $10,000,000 / 6990,480,000 sq. nm hour
ROTHR cost= $0.001 per sq. nm hour
GBR costs= O&M / ESTC gbr
GBR costs= $100,000,000/ 176,842,500 sq. nm hour
GBR costs= $0.565 per sq. nm hour
AEW costs= O&M for all five AEWs/ ESTC aew
AEW costs= 18,000,000/ 520,506,000 sq. nm hours
AEW costs= $0.346 per sq. nm hour

would provide dual coverage that would benefit both countries and limit equatorial anomalies. Brazil is undoubtedly aware that it is in the U.S. national interest to provide assistance with low altitude surveillance for counter-drug purposes in the Amazon region. Dual coverage would be mutually beneficial for it would support U.S. national drug control strategy, while improving SIVAM's ability to support Brazilian counter-drug efforts and OOTW.[28]

According to the *Congressional Record*, the use of a fourth ROTHR is being considered by the U.S. Congress under a bill named "Western Hemispheric Drug Elimination Act".[29] In 1998, the Department of Defense and Central Intelligence Agency were tasked with preparing a report examining:

> ...the options available to the United States for improving Relocatable Over the Horizon (ROTHR) capability to provide enhanced radar coverage of narcotics source zone countries in South America and transit zones in the Eastern Pacific. The report shall include— 1) a discussion of the need and costs associated with the establishment of a proposed fourth ROTHR site located in the source or transit zones; and 2) an assessment of the intelligence specific issues raised if such a ROTHR facility were to be established in conjunction with a foreign government.[30]

This report may provide an opportunity for the Brazilian government to work with the U.S. in integrating a ROTHR site into SIVAM on Brazil's terms. ROTHR could probably be added into the existing SIVAM contract, with Raytheon as the contractor, using EXIMBANK financing.

If Brazil integrates a ROTHR into SIVAM, it should incorporate its OCC into the Ground Control Center (GCC) in Brasília. The ROTHR transmit and receive sites should be located away from the Amazon region in areas with good infrastructure, such as southern Brazil. FAB personnel could staff the sites.

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[28] McCaffrey, Barry, *1999 National Drug Control Strategy,* Washington D.C.: Office of National Drug Control Policy, 1999.

[29] Congress, House, *Western Hemisphere Drug Elimination Act of 1988,* 105th Cong., H.R. 4300, *Congressional Record,* 16 September 1998. Available [Online]: <http://www.thomas.loc.gov> 18 May 1999.

3. Potential Problems with ROTHR

There are five potential problems with ROTHR that can be overcome or negotiated. They are 1) system cost; 2) infrastructure requirements; 3) requirement for technically qualified operators; 4) limits of single coverage; and 5) degradation due to equatorial anomalies.

ROTHR is an expensive system. The estimated cost for acquisition in 1989 was $70 million, and is probably higher today.[31] The existence of an available ROTHR prototype that needs to be upgraded (rather than a whole new system) will probably lower this cost.[32] As stated earlier, yearly O&M costs in the United States are approximately $10 million, but would probably be significantly lower in Brazil due to lower labor and material costs in country.[33] Construction costs for the Puerto Rico ROTHR were estimated at $10 million for both transmitter and receiver sites.[34] In comparison, construction costs would vary due to the suitability of terrain. In Brazil, it would probably be lower due to the availability of open land. OCC installation costs would be significantly lower if installed at the time of SIVAM's CCG construction.

A ROTHR requires good supporting infrastructure. Power consumption is high. According to Raytheon, a typical ROTHR receiver uses 350 KW, transmitter 1200 KW, and the OCC 300 KW.[35] The Puerto Rico site receiver will use 500 KW.[36] The transmitter and receiver must be separated by 50 to 100 miles to permit bistatic operation.[37] The transmit site and receive sites are both large at 49 and 99 acres respectively.[38] Both require level open spaces free of obstruction. For instance, the

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[30] Ibid.
[31] Hughes, 27.
[32] Interview with Robert M. Williams.
[33] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," 7766.
[34] Ibid.
[35] Anthony Merti, Program Manager, Raytheon ROTHR Program Office- Engineering, Telephone interview by author, Daligren VA, 24 May 1999, Raytheon Corporation.
[36] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico," 7766.
[37] "Record of Decision for the Installation and Operation of a Relocatable Over the Horizon Radar (ROTHR) System in Puerto Rico."
[38] "Relocatable Over-the-Horizon Radar Unclassified Briefing," (Chesapeake, VA: Fleet Surveillance Support Command, 3 September 1999, photocopied).

receive site is composed of one large gain antenna 3,800 meters (8,400 feet) long with 372 monopoles, each 8.6 meters (19 feet) tall.[39]

A ROTHR also requires technically proficient operators. According to *Aviation Week and Space Technology*, each ROTHR transmit and receive site is manned by forty people.[40] A Brazilian ROTHR would require approximately fifty personnel to man its sites and the OCC.[41] Some technicians would have to be U.S.-trained.

A single ROTHR can provide usable, albeit not always reliable, early warning coverage against low altitude small aircraft (and could still contribute toward attrition of illegal aircraft). A single ROTHR is also more vulnerable to ionospheric disturbances, as operators cannot fall back on another ROTHR covering the same area using its own ionosphere. A single ROTHR also suffers from a phenomenon known as "Doppler dead-band" where aircraft flying perpendicular to the radar's line of sight will not be detected.[42] These problems are mitigated with dual coverage.

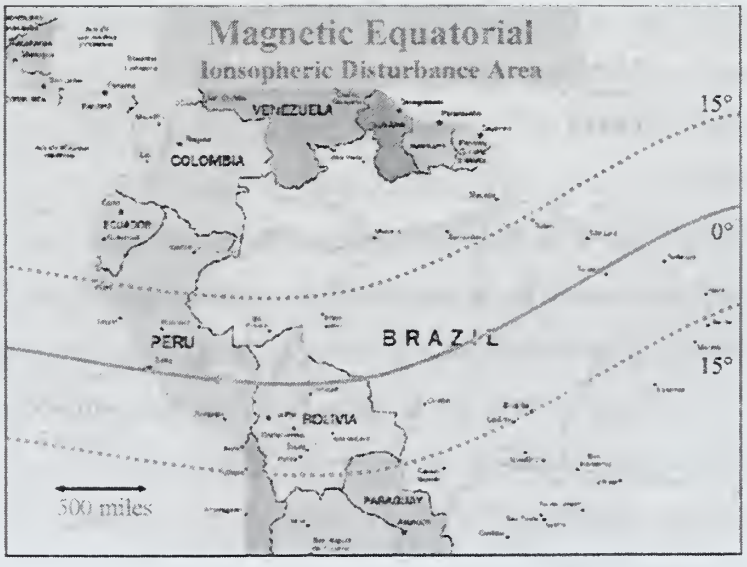

Figure 8. Areas of Greatest Ionospheric Disturbance in South America Degrees are magnetic. From L.J. Nickisch and Kenneth Davies, 44.

[39] "Virginian ROTHR System Covers Caribbean Drug Smuggling Routes," 80.
[40] Ibid.
[41] Anthony Merti estimated approximate manning requirements in the U.S. (with OCC controlling three radars) at 10 for receive site, 14 in transmit site, 40 in OCC and 8 for maintenance. A Brazilian OCC controlling one radar would probably require about 20 people. Anthony Merti, Program Manager, Raytheon ROTHR Program Office- Engineering, Telephone interview by author, 24 May 1999, Dahlgren VA, Raytheon Corporation.
[42] Interview with Robert M. Williams.

A weakness of a ROTHR is the periodic degradation of performance in the equatorial belt. All Doppler OTH radars are degraded by ionospheric disturbances generally within fifteen degrees north and south magnetic (see Figure 8). [43] In South America, the magnetic equator is several degrees south of the geographic equator and is plagued by severe disturbances.[44]

Disturbances vary depending on diurnal, seasonal and sunspot activity, and thus are somewhat cyclical in nature. Turbulence increases at night and during high sunspot activity (which occurs on an eleven year cycle next peaking in 2001).[45] Several equatorial anomalies such as spread Doppler clutter (or Equatorial Spread-F (ESF)), electrojets (Sporadic-E) and ion plumes distort radar signals bouncing off the ionospheric "mirror".[46] The extent of degradation of OTH radars in the southern equatorial is subject to debate and will probably be researched for some time into the future.[47] More will be known regarding the extent of detection degradation in the equatorial after Puerto Rico ROTHR comes online in 2000. The U.S. decided to forgo long-term ionospheric impact studies for Puerto RICO ROTHR as they would be costly and inconclusive.[48] Regardless, OTH radar is still usable in the equatorial belts. For example, Australia successfully uses OTH radars with the JINDALEE system that is located in the equatorial region.[49] Further, ionospheric modeling techniques are being used to better access and

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[43] Dr. L. J. Nickisch, Senior Scientist- Communications/Radar Systems, Interview by author, 4 June 1999, Monterey, CA, Mission Research Corporation; Dr. Rasler Smith, Assistant Research Professor for Electrical Engineering, Interview by author, 22 May 1999, Monterey CA, Naval Postgraduate School.

[44] Interview with Dr. Rasler W. Smith.

[45] Kenneth Davies, *Ionospheric Radio*, London: Peter Peregrinus Ltd., 1990, 44.

[46] Spread-F is ionospheric F-layer irregularities that distort radar signals and mask targets. Sporadic-E is a layer of strong ionization at altitudes of 100 kilometers that reduces energy of targets. Other instabilities are electro-jet (current) , bubbles and plumes. See "Application of Over the Horizon (OTH) Radar Technology to the SIVAM Program," 4.

[47] Barry Crane, Project Director, Telephone interview by author, 24 May 1999, Washington D.C., Institute for Defense Analysis; Interview with Anthony Merti; Interview with Dr. Rasler Smith; Dr. Joseph Thomason, Systems Section Head, Advanced Radar Section, Radar Division, Telephone interview by author, 28 May 1999, Washington D.C., Naval Research Lab; Interview with Dr. Bill Wortman; Interview with Dr. L. J. Nickisch; Interview with Robert M. Williams.

[48] Interview with Robert M. Williams.

[49] For more information on JINDALEE see D.H. Sinnot, "The Development of Over-the-Horizon Radar in Australia," *Defense Science and Technology Organisation,* 1998. Available [Online]: <http://www.dsto.defence.gov.au/corporate/publicity /brochures/othr/othr9.html> [13 July 1999].

improve HF radar performance in equatorial areas.[50] Impacts from ionospheric anomalies are decreased if the radar look angle is oriented north south. Lack of knowledge regarding the extent of degradation implies a certain risk in placing a ROTHR in the southern equatorial. The U.S. government faced such a risk regarding the Puerto Rico ROTHR, since it was known equatorial anomalies could impact its long-range coverage. According to Robert Williams of U.S. Southern Command, after an extended period of analysis, the U.S. government determined that the benefits with proceeding with ROTHR outweighed the risks of performance degradation from equatorial disturbances.

The effectiveness of a ROTHR in Brazil can be assessed in two ways: 1) probability of detection and 2) ability to accurately track a target. Generally, a ROTHR in Brazil would have a high probability of detection during periods of low sunspot activity and during the day. Under ideal conditions, the probability of detection of illegal aircraft can be as high as 90 percent.[51] A ROTHR operator could not predict probability of detection in advance (as could not a trafficker). Over a period of years, equatorial ROTHR users would notice that probability of detection vary in a cyclical manner.[52] The operator would know in real-time how well the radar is operating in a given area of coverage. Ionospheric physicists and radar engineers have applied modeling to assess the performance of a southern OTH radar covering the equatorial region.[53] San Diego based Mission Research Corporation concluded that a OTH in a southern location like Brazil will work greater than seventy percent of the time on an annual average.[54]

Equatorial anomalies can also degrade ROTHR's ability to accurately locate a target. Placing HF beacons in fixed locations in the area of coverage greatly improves target location accuracy. Beacons or transponders placed on board intercept aircraft also mitigate this deficiency, as the relative position to the target would be accurate, even if locations were not.[55]

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[50] Ibid.
[51] "Application of Over the Horizon (OTH) Radar Technology to the SIVAM Program."
[52] Interview with Dr. Rasler W. Smith.
[53] Interview with Dr. L.J. Nickisch.
[54] Dr. Bill Wortman, Senior Scientist, Telephone interview by author 2 June 1999, San Diego CA, Mission Research Corporation.; Interview with Robert M. Williams; Interview with Dr. L.J. Nickisch.
[55] Interview with Robert M. Williams.

ROTHR's capabilities are being "continuously upgraded with new hardware and software under contracts to Raytheon and others" for use in the equatorial areas.[56] According to *Jane's,* the probability of accurate tracking performance is increased if the unstable ionospheric conditions are monitored frequently. ROTHR has the capability of conducting this monitoring from the sensor location vice remote downrange sounding radars with "...a Quasi-Vertical Incidence (QVI) sounder and a backscatter sounder to accurately model the ionosphere using propagation management and assessment (PMA) algorithms."[57] A ROTHR's performance capability can also be improved with tools such as ionospheric ray tracing and the use of real-time three-dimensional ionospheric modeling.[58] For example, Mission Research Corporation has developed a cutting edge detailed worldwide ionospheric model. It is known as the Clutter Effects Model (CLEM). It uses sounding data to plot radio wave propagation and generate ion grams. The ion grams provide an accurate geophysical model of the equatorial ionosphere over the Amazon region.[59] Data from these models can be incorporated into a ROTHR to enhance its performance and accuracy in disturbed areas.

4. Potential Solutions

As discussed earlier, dual coverage is preferred. The SIVAM ROTHR limitations could be nearly eliminated if data were exchanged with the Puerto Rico ROTHR. The United States would probably share this data especially if it could negotiate to acquire some data (e.g., covering major drug trafficking lanes over Peru and Colombia) from the Brazilian ROTHR. Brazil could then achieve dual coverage within the SIVAM ROTHR (see Figure 7, page 77).[60]

The creation of a centralized surveillance body for coordination, prioritization and deconfliction would ensure effective SIVAM operations in a more efficient and

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[56] "Relocatable OTH Radar (AN/TPS-71)."; "Beyond the Horizon, But Not Out of Sight: Improving ROTHR Ship Detection," *International Defense Review* 30, no. 8 (1 August 1997): 50.
[57] "Relocatable OTH Radar (AN/TPS-71)."
[58] Interview with Dr. Bill Wortman.
[59] L. J. Nickisch, Senior Scientist- Communications/Radar Systems, Interview by author, 4 June 1999, Monterey, CA, Mission Research Corporation.

equitable basis given the diverse surveillance clientele. This body would be equipped to handle foreign interactions including possible cooperation with the United States.

Establishing a mechanism of oversight would ensure protection against abuses in civil liberties and the occurrence of corruption. Brazil emphasizes respect for human rights, especially as it does not want a repeat of abuses conducted by security/ intelligence services during the military regimes from 1964 to 1985. Hence, it is in the Brazilian government's interest to maintain SIVAM in good public standing.

Negotiating with the U.S. to gain access to Puerto Rico ROTHR data covering the region would improve the surveillance capabilities of SIVAM's architecture. Concurrently, Brazil could incorporate a ROTHR into SIVAM. SIVAM with a ROTHR would have improved capabilities such that it could help Brazil to be a regional leader in counter-drug efforts. Even while accounting for degradation from equatorial ionospheric disturbances, a southern ROTHR would provide on average a seventy percent probability of detection of low altitude aircraft. Puerto Rico data covering the equatorial region would further improve the probability of detection by providing dual coverage of the Amazon. A Brazilian ROTHR would complement existing capabilities (such as AEW mission planning) and decrease SIVAM's limitations in detecting low altitude aircraft. ROTHR can provide high space-time coverage and cost-effectiveness relative to other radar systems even in an equatorial environment. For the border case examined, ROTHR is estimated to provide approximately ten times the space-time coverage of SIVAM's combined AEW and GBR systems at a fraction of their cost.

The most effective way to mitigate SIVAM's deficiencies in order to better support combatting problems in the Amazon region is for the United States and Brazil to mutually increase cooperation between the two nations, especially in the areas of ROTHR data sharing to combat drug trafficking. This cooperation would improve SIVAM's organizational effectiveness and improve overall surveillance of Brazil's sovereign borders and airspace. It would also provide another tool for Brazil in its regional leadership role.

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[60] The author made this assessment after analyzing overlapping range fans for two radars- one in Puerto Rico and one in South America (Brazil or Paraguay).

VII. CONCLUSIONS

SIVAM's construction in the Brazilian Amazon began in 1998 and it will be at least five years before the project's architecture is fully operational. SIVAM is a good case study for complex interdependence as it increases the number of state and non-state linkages in the arena of bilateral foreign relations between the U.S. and Brazil. The involvement of state and non-state actors in the foreign affairs of both countries began, at least in regards to SIVAM, in the late 1980s. For example, the U.S. government established a multi-agency advocacy team, led by Commerce Department, to assure U.S. private sector (Raytheon) involvement in the SIVAM contract bidding. Without this interagency advocacy effort, it is unlikely that Raytheon would today participate in the development of Brazil's SIVAM. Raytheon's participation in SIVAM provides the U.S. private sector an important role in the future of the Amazon region. Raytheon's involvement in SIVAM indirectly supports U.S. governmental interests in the region. Hence, SIVAM could be a venue for future regional cooperation in the Amazon (e.g., regional counter-drug efforts), as well as increased linkages between Brazil and the United States.

SIVAM's surveillance capability will provide substantial amounts of intelligence on activity in the Amazon region. SIVAM will also assist the Brazilian military in projecting Brazil's security interests and sovereignty in the region. SIVAM completion is crucial if one considers that at present the region is experiencing an increase in "gray area" threats such as drug trafficking, narco-guerrilla incursions, and environmental degradation.

SIVAM has organizational and architectural limitations that might be improved through greater U.S. government and/or private sector cooperation. For example, with U.S. assistance, SIVAM might be organizationally improved with the establishment of a coordinating body that is capable of interfacing with regional and international counterparts. The body should be subject to high-level Brazilian oversight in the Executive and/or Legislative branches in order to protect SIVAM from corrupting influences.

SIVAM's surveillance architecture can also be improved with the use of OTH radars, such as ROTHR, that are capable of covering large areas of low altitude airspace. With U.S. cooperation, a ROTHR might be installed and integrated into SIVAM. If a Brazilian ROTHR is built, then further cooperation with the United States might occur in the area of ROTHR data sharing. Accordingly, both countries would mutually benefit, due to ROTHR dual coverage in certain areas of the Amazon and the Caribbean, if they shared each radar system's aircraft track data. More importantly, if SIVAM is built with maximized low altitude coverage capabilities, it could help Brazil establish regional leadership on issues such as counter-drug.

As surveillance improves, the demand on Brazilian resources and personnel to respond to problems in the Brazilian Amazon will be significant. For example, the Brazilian military, supported by SIVAM intelligence will probably have to respond to more OOTW. Other government agencies such as the Federal Police will also rely on SIVAM's surveillance data. Consequently, it is likely that Brazil will accept U.S. assistance during crises due to SIVAM's data causing high operational tempo on Brazil's law enforcement units and personnel. The most likely scenario for U.S. support is in the arena of military-to-military contacts. U.S. assistance could range from providing more technological assistance for SIVAM, supplying logistical support, supporting unilateral Brazilian OOTW, and even cooperating in military operations.

Regardless, U.S. involvement in Amazon crises will test Brazil's strong sense of sovereignty and thus will be a contentious issue in the future. One scholar involved in SIVAM's design summed it well when he said, "SIVAM is basically the tool to make policy decisions. Its effective use will depend on whether they [Brazil] have the resources to implement the policies." [1]

In summary:

1) SIVAM possesses significant military applications such as intelligence gathering, early warning, aerial interception, and surveillance for Brazilian OOTW such as border security, counter-drug, and environmental protection. SIVAM's space and

[1] The scholar is David Skole from the University of New Hampshire. Scott Allen, "'Eye' on the Rain Forest Relies on Space, Ground, Air Sensors," *Boston Globe (MA),* 31 March 1997, C1.

aerial collection capabilities also have military and intelligence applications. Assets include air and ground surveillance radars, satellite and aerial imaging capabilities, and communications intercept. These assets are well suited to monitor Brazil's borders and support national sovereignty.

2) SIVAM's capability to detect problems in the Amazon has significant implications for Brazil's military and police in that each entity's operational response to illegal activities in the Amazon will increase. These will place a strain on each body's resources and personnel.

3) The Brazilians have not yet identified an overarching coordinating body and oversight mechanism for SIVAM.

4) U.S. bilateral relations with Brazil could strengthen especially if SIVAM capabilities result in Brazil requesting assistance and/or increasing cooperation with the U.S. military, law enforcement units and intelligence organizations, (especially in the counter-drug domain). However, U.S. governmental agencies or entities will cooperate if it is in their interest or are directed by the President. Ultimately, ROTHR data sharing to support regional cooperative counter-drug efforts is in the interest of each nation.

Suggestions for further research are: 1) analyze the relationship between Brazil's central and state governments and how they affect SIVAM's construction and operational effectiveness in the Amazon; 2) explore how the new Ministry of Defense will utilize SIVAM and how this impacts Brazilian military joint service interaction/ coordination; 3) explore how Raytheon's SIVAM contract is a model case study on U.S. government advocacy to help U.S. business abroad and increase bilateral linkages with other countries; and 4) analyze how a SIVAM-like architecture might help other developing countries (e.g., Indonesia) monitor and respond to their own problem areas.

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APPENDIX. BRAZILIAN AND U.S. GOVERNMENT DOCUMENTS

[1]

THE WHITE HOUSE

WASHINGTON

June 23, 1994

Dear Mr. President:

My Administration has closely studied Brazil's proposed Amazon Surveillance System (SIVAM) and has expressed strong support for U.S. firms competing for this important project. I would like to add my personal support for U.S. industry.

I know Brazil will benefit from the advanced technology offered by the U.S. companies. The U.S. Government has provided a competitive financial package to complement the U.S. industry's superior technical offering.

Selection of U.S. firms could create opportunities for cooperation in environmental monitoring and protection, air traffic control and counter-narcotics efforts and expand our mutually beneficial commercial relationship.

Secretary of Commerce Ron Brown can explain fully to your officials the benefits of selecting U.S. industry.

His Excellency
Itamar Franco
President of the Federative
Republic of Brazil
Brasilia

OFFICE OF THE DEPARTMENT OF DEFENSE COORDINATOR
FOR DRUG ENFORCEMENT POLICY AND SUPPORT

1510 DEFENSE PENTAGON
WASHINGTON DC 20301-1510

30 OCT 1995

Senator Gilberto Miranda
Senado Federal
Bloco B - Gabinete 66
Brasilia - DF
70165-900

AFW
MMS
EAC
AWP
AV
TG
RN/MM
PPC/P
USOAS
ARA/S

Dear Senator Miranda:

I enjoyed meeting with you on October 19 to discuss the challenges facing Brazil in combatting the flow of illicit drugs through your country. I look forward to a continuing dialogue with the Brazilian government on narcotics trafficking.

I appreciated the opportunity to respond to your questions on some of our counterdrug programs operating in the Carribbean and South American regions. On the subject of the two over-the-horizon radars the Department is operating for counterdrug purposes, I believe two points we discussed deserve repeating. First, although the over-the-horizon systems do in fact provide data that is very suitable for tracking suspected narco-trafficking aircraft, they do lack the precision required for uses such as air traffic control. Secondly, although the radars are susceptible to ionospheric anomalies, we believe that stationing our next radar in Puerto Rico will result in only minimal periods of disturbance and will provide for quality coverage of the Andean region. I understand, however, that a ROTHR in Brazil would be subject to more frequent periods of degraded coverage because of its proximity to the equator, which would seriously compromise or negate its ability to perform reliable surveillance of the Amazon region.

Again, it was a pleasure to meet with you and I look forward to working more closely with Brazil in our efforts to stop drug trafficking.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

June 23, 1994

His Excellency
Admiral Mario Cesar Flores
Secretary of Strategic Affairs
Palacio do Planalto
Brasilia, Brazil

Dear Secretary Flores:

The Government of the United States of America values greatly its relationship with Brazil and Brazil's projects which are potentially of benefit throughout the hemisphere. We are particularly interested in supporting United States industry in regard to such Brazilian projects. In this regard, your Amazon Surveillance System (SIVAM) is of particular importance as the first phase of a broader program known as the Amazon Protection System (SIPAM) unveiled at the Rio '92 United Nations conference on the Environment and Development. Accordingly, SIVAM is of the highest interest to U.S. industry, and the United States Government strongly supports U.S. industry in its efforts to be of service in regard to the SIVAM project.

I am pleased to report that the financing package backed by the United States Government and presented to you is very competitive and should be given every consideration as meeting your requirements for a foreign financing proposal.

As you know, agencies of the United States Government have corresponded with you directly to endorse the SIVAM project and the participation of U.S. industry. Further, I draw to your attention the long history of collaboration between the United States and Brazil on issues relevant to the subject matter of the SIVAM project. This history of collaboration has included the following matters, many of which are continuing:

The Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

- NOAA values its longstanding cooperation with its counterpart Brazilian agencies, such as the Instituto Nacional de Pesquisas Espaciais (INPE). SIVAM provides an excellent opportunity for NOAA and its Brazilian partners to strengthen and expand activities in operational forecasting for meteorology and hydrology, climate analysis, and environmental satellite data processing, distribution, and archiving. NOAA would look forward to discussing these opportunities.

The National Aeronautics and Space Administration (NASA)

- Joint scientific campaigns involving field studies, aircraft flights, and sounding rockets
- Training in satellite data analysis and global change research in collaboration with other USG agencies

The Department of Agriculture, U.S. Forest Service

- Collaborative research on biodiversity
- Scientific and technical exchanges regarding soils and soil conservation
- Research on Forest Fire Science and Management. Information from research will be the basis for the development of a national plan
- Training in the United States of Brazilian firefighters on Fire Prevention and Control
- Training in Forest Management of Brazilian forest managers and non-government organization leaders
- Cooperation on land, timber and wildlife management
- Training of environmental officials on principles of Environmental Assessment
- Research on Economic Potentials of Ecotourism in the Atlantic Rain Forest ecosystem within the state of Parana and the Amazon Rain Forest within the state of Para

The Department of the Interior, U.S. Geological Survey

- Satellite data processing support for the NASA Landsat Pathfinder Tropical Deforestation Project in the Amazon Basin
- Cooperating with the Instituto Nacional de Pesquisas Espaciais (INPE) to collect 1-km resolution NOAA Advanced Very High Resolution Radiometer satellite data over Brazil and neighboring countries as part of a multinational effort to obtain global coverage for use in land cover mapping and monitoring
- Real-time global telemetered seismic data acquisition system and network (cooperating with the University of Brazilia)

The Environmental Protection Agency

- EPA and its counterparts in Brazil enjoy longstanding cooperation on the environment. Of particular interest in recent years has been cooperation in the areas of management of marine and freshwater pollution, hazardous wastes, and pesticides and toxic substances. EPA has been working with the U.S. Agency for International Development to provide environmental assessment training for organizations working in the Amazon. EPA is also providing support for a greenhouse gas emissions inventory as part of the work of the Intergovernmental Panel on Climate Change.

The Department of Transportation, Federal Aviation Administration

- Training in ATC Systems Operation

I am also pleased to report the support of the Department of State and the U.S. Trade and Development Agency for the U.S. consortium competing for the SIVAM project.

The foregoing indicates the United States Government strong endorsement of this project going forward with the extensive participation of U.S. industry.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

January 31, 1994

His Excellency
Admiral Mario Cesar Flores
Secretary of Strategic Affairs
Palacio do Planalto
Brasilia, Brazil

Dear Secretary Flores:

I am writing in support of U.S. industry which is competing supply technology, equipment, and services needed to implement Brazil's Amazon Surveillance System (SIVAM). It is my understanding that SIVAM is the first phase of a broader program known as the Amazon Protection System (SIPAM) which was unveiled at the RIO '92 United Nations Conference on the Environment and Development.

I applaud your efforts in designing SIVAM to balance environmental concerns with economic development in the region and share your interests in improving air traffic safety over the Amazon basin. We also strongly support your goals of applying SIVAM to improve your ability to monitor and detect illegal narcotics and mining activities in the region, and your efforts to better protect the health and safety of all the inhabitants of the Amazon region.

U.S. manufacturers are the world leaders in providing solutions to complex electronic data collecting and telecommunication programs, such as SIVAM. U.S. manufacturers are also second to none in providing state-of-the-art air traffic control network systems, satellite image processing, and airborne surveillance systems. By offering their extensive experience and effective hardware and software, which has been proven in the field in extreme conditions such as those found in the Amazon region, the participation of U.S. firms can greatly reduce the risks, time, and costs normally associated with developing and integrating a program of this magnitude.

U.S. firms will be submitting their technical and commercial proposals by February 5, and are striving to present financial proposals by April 5. As you are aware, obtaining financing for a project of this nature is very difficult. I can assure you that the U.S. firms competing for the SIVAM project are working hard to obtain the most favorable financing available.

[7]

I urge you to study the U.S. proposals carefully. U.S. industry participation in SIVAM will assure the highest levels of quality, value, technology, experience, and service available worldwide.

Sincerely

2/7/04 - 17:46:40 LIDER TAXI AEREO S.A. - Rio de Janeiro 2/2

Letter number 008/PR-CCSIVAM/CC/0095 Rio de Janeiro, 5 July 1994

From the President of CCSIVAM

To His Excellency Mr. David Zweifel
Consul US
Rio de Janeiro

Subject: SIVAM Project - Surveillance Aircraft

I am honored to inform you that, on 29 June, the Minister of SAE, through his letter number 0373/94-SAE PR, asked the Minister of Foreign Affairs to inform the Government of your Country that the explicit purpose for the missions performed by the Early Warning Aircraft (AEW) in the Amazon region is of surveillance, mainly against drug traffic

I take the opportunity to reaffirm to you, supplementary, that these aircraft, and equipment that are related to them, will be used, primarily, against narcotraffic This determination was already stated, a long time ago, in the documents generated by this Commission for the conception and configuration of the SIVAM Project.

Brig. Do Ar. - Marcos Antonio de Oliveira
President CCSIVAM

Of.nº 008/PR-CCSIVAM/C|0065 Rio de Janeiro, 05 de julho de 1994.

Do Presidente da Comissão para Coordenação do Projeto do Sistema de Vigilância da Amazônia - CCSIVAM

Ao Exmo.Sr.David Zweifel
MD Cônsul dos Estados Unidos da América no
Rio de Janeiro - RJ

Assunto: Projeto SIVAM - Aeronaves de vigilância

Tenho a honra de levar ao conhecimento de V.Exa. que, em data de 29 de junho do ano corrente, o Exmo.Sr.Ministro-Chefe da Secretaria de Assuntos Estratégicos da Presidência da República, através de seu Aviso nº 0373/94-SAE-PR, solicitou ao Exmo.Sr.Ministro das Relações Exteriores do Brasil que informasse ao Governo do vosso país que a destinação precípua das missões que serão realizadas pelas aeronaves de alarme antecipado (AEW), na Região Amazônica, é de vigilância, notadamente contra o tráfico de drogas.

2. Aproveito a oportunidade para reafirmar à V.Exa., complementarmente, que essas aeronaves, assim como os equipamentos a elas vinculados, serão usados, primariamente, contra o narcotráfico, inclusive porque tal determinação já consta, há muito tempo, dos documentos gerados por esta Comissão, a partir da concepção e configuração do Projeto SIVAM.

3. Apresento a V.Exa. meus protestos de estima e consideração.

Informal Translation of Diplomatic Note from the
Government of Brazil
Certifying Counternarcotic Applications of SIVAM

The Ministry of Foreign Relations extends greetings to the Embassy of the United States of America, and, with reference to the offering of the EXIM Bank of the United States of America to finance AEW (Air Early Warning) aircraft as part of the Amazon Surveillance System (SIVAM) project, has the honor to confirm that these aircraft will be utilized primarily to support actions to combat illicit activities involving narcotrafficking and smuggling, and environmental abuses occuring in the Brazilian Amazon region.

Initialed

(Roberto Abdenur)
(Acting Minister of Foreign Relations)

Brasilia
July 8, 1994

UNITED STATES DEPARTMENT OF CC
The Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

JUN 10 1994

His Excellency
Admiral Mario Cesar Flores
Secretary of Strategic Affairs
Palacio do Planalto
Brasilia, Brazil

Dear Secretary Flores:

I am writing in support of U.S. industry proposals to provide the National Oceanic and Atmospheric Administration (NOAA)-related technology, equipment and services for your Amazon Surveillance System (SIVAM). I urge you to examine the U.S. proposals carefully because they offer potential collaborative activities for using data directly received from NOAA's environmental satellites--Geostationary Operational Environmental Satellites (GOES), Polar-orbiting Operational Environmental Satellites (POES), and Landsat--or from other NOAA-related, ground-based U.S. technologies.

NOAA has enjoyed long-standing relations with your Instituto De Pesquisas Espaciais as well as other Brazilian agencies involved in SIVAM under other bilateral cooperative agreements and in several multilateral intergovernmental organizations or coordinating groups. Some of these have included the joint research projects in meteorology and oceanography under the U.S.-Brazil Science and Technology Agreement (STA). Using NOAA-related U.S. technologies in SIVAM could indirectly enhance some joint research activities under STA. SIVAM could strengthen our institutional ties in environmental monitoring of the Amazon using U.S. technologies associated with GOES, POES and Landsat.

I believe that U.S. participation in SIVAM using NOAA-related technologies would provide the highest levels of quality, value, experience and service available.

Sincerely,

THE ADMINISTRATOR

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

JAN 22 1994

His Excellency
Admiral Mario Cesar Flores
Secretary of Strategic Affairs
Palacio do Planalto
Brasilia, Brazil

Dear Secretary Flores:

I am writing to you regarding the Amazon Surveillance *System (SIVAM) program.*

I understand that you are now considering offers from industry in the U.S. and elsewhere to assist Brazil in the development of this important program. Since its inception, NASA has worked to develop systems for the monitoring of the Earth's environment from space and has played a major role in developing the capabilities of U.S. industry in this regard. Indeed, U.S. industry has been NASA's partner in its continuing effort to learn more about our changing global environment.

For this reason, NASA is confident that U.S. industry combines both the experience and commitment to quality to make it an excellent choice for a program *such as SIVAM.* Technically, I believe U.S. industry to be the most qualified in the world today in the field of environmental monitoring from space.

I wish you all the best as you complete the difficult selection process for your SIVAM program.

Administrator

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